



**The correlation between urban form and travel
behavior to have climate comfort.**

العلاقة بين الشكل الحضري والتنقل للحصول على الراحة المناخية.

by

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of the requirements for the degree of
MSc SUSTAINABLE DESIGN OF THE BUILT
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Abstract

People attitude one of the most valuable tools in the urban planning process; it gives a broad vision of the alternative that could do during the planning process. Travel behaviour can reflect the way that resident prefer to their city to be like, the level of mature and awareness to the serious issues that can affect the developing process. The focus of this study is to examine the impact of urban form on the travel behavior to gain the climate comfort and to figure out a balance between top down and bottom up planning. The case study of the Sharjah city will present to examine this hypothesis. The aim of this study is to investigate the social construction of urban form on the travel behavior to gain the climate comfort in the microclimate scale to find a justified balance between all of these parameters to achieve sustainability. The importance of the study is that it should provide the richness of a case study scenario to underpin the impact of the social construction of the urban form and provide a significant understanding of urban form and its implications on the environment. Interviews will be semi-structured and collaborative to generate data, which will contribute to an understanding of how people attitude expectations influenced “lived experience.” On the other hand, it provides a basic tool to understand the travel behaviour of different level of the community as it will hold in the United Arab of Emirates. It has a variety of culture, religion and education background. Based on previous knowledge and practical experiment, and preceding studies; the approach to sustainable urbanism is an urgent need to the development of countries; it reflects the level of civilization of nations. In this research, it will more focus on achieving holistic sustainable development practices to a neighbourhood so people could live at a decent level and give a panoramic view to all aspects of sustainability to get at the end a smart design. The main issue here is the well-being of people and their condition whether it is psychological, social, and economic or even climatically comforts.

Keywords: sustainable development, urban form, travel behaviour, micro urban development.

ملخص

دراسة السلوك الإنساني من أهم الأدوات المستخدمة أثناء عملية تخطيط المدن، لأنها تعكس ما يحب أو يكره الناس في مدنهم. كذلك توضح مستوى الوعي لدى الناس للأمور المحيطة والمستجدات على المنطقة والتي تؤثر بشكل أو بآخر على التنمية في المنطقة. جاءت هذه الدراسة لتوضيح أثر التشكيل الحضري للمدينة على السلوك الإنساني للتنقل وذلك ضمن المعالجات البيئية لضمان راحة السكان. تمت الدراسة لمنطقة معينة في مدينة الشارقة من خلال استبيان يعكس مدى وعي الناس لمنظومة التنقل والمرور في المنطقة ومدى الرضى عن الخدمات او طرق المواصلات المتوفرة بالمنطقة. بالإضافة الى مقابلات مع ذوي الاختصاص لتقييم الوضع الراهن والاطلاع على الخطط المستقبلية إن وجد. دولة الامارات المتحدة تتشكل من بيئات وثقافات متنوعة مما يشكل تحدي وبنفس الوقت تميز. تحدي لأنه يقلل من معدلات الرضى العام عن الخدمات المطروحة، وتميز لأنه يزيد من فرص استخدام بدائل متنوعة من طرق المواصلات. لكن لا بد من التطرق لمثل هذه الدراسات لأنها تثري التجربة التطويرية للمدن وتزيد من الواقعية والمنطقية. والاهم هو تحسن حياة السكان والارتقاء نحو بيئة عمرانية صحية وأمنة وفي اعلى معايير التطور.

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Abbreviations

CFD	Computational Fluid Dynamic
ERC	Government's Economic and Social Research Council
EPA	Environmental Protection Agency
GCC	Gulf Cooperation Council
ICT	Information and Communication Technology
LCZ	Local Climatic Zone
MIT	Massachusetts Institute of Technology
OD	Origin Destination
RTA	Road and Transport Authority
Tmrt	Mean Radiant Temperature
SD	Sustainable Development
SDC	Sustainable Development Commission
SDTME	Smart Dynamic Traffic Monitoring and Information Towers
SDTPS	Sharjah Directorate of Town Planning and Survey
SPOT	Spatial Positioning Tool
SUMO	Simulation of Urban Mobility
TIS	Traffic Impact Studies
TOD	Transit oriented Development
UE	United Europe
UHI	Urban Heat Island
VGA	Visual Graph Analysis
WCED	World Commission on Environment and Development

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1.1.Introduction

Humankind is a vital and unique in the whole universe; all creatures found to serve the human kind and to help them to continue their life. *“He has subjected to you whatsoever is in the heavens and the earth; all is from Him. Surely, there are signs in this for people who contemplate.”* (Al-Jathiah, 13). Therefore, it is important to give attention to the people needs and try to fulfil that needs with considering the proper use of the resources. This study is all about the people. How to make them perform their life in more peace and relief, it is about designing a community to them. To give them a feeling of possessing it. Therefore, they admire and respect the space they live in. Many urban theories and proposed approaches were revealed to help in designing real communities. The Urban study has a broad discipline and many parties that affect the planning system. One of the most question that coming to the mind that *which is more affecting in the planning process; the top-down approach or the bottom-up approach, especially in travel plan theories?* Moreover; application to this kind of study is limited. Two studies have applied the top-down implementation, and no studies applied to the bottom-up approach in travel planning field to date (De Gruyter, 2016). Table (1) shows the main difference between the two methods.

Table 1: Comparison between top-down and bottom-up approaches (Paudel, 2009).

Characteristic	Top-Down Approach	Bottom-Up Approach
Policy decision-maker	Policymakers	Street-level bureaucrats
Starting point	Statutory language	Social problems
Structure	Formal	Both formal and informal
Process	Purely administrative	Networking, including administrative
Authority	Centralization	Decentralization
Output/outcomes	Prescriptive	Descriptive
Discretion	Top-level bureaucrats	Bottom-level bureaucrats

In the top-down approach, has the ability to present a clear implementation. Nevertheless, in case of no dominant agency application will be limited. Moreover; in most cases it ignores the strategies used by bottom-up approach for own purpose. On the other hand, bottom to up approach can deal with policies because of multitude of actors. In addition, it gives attention to all consequences of any program. However, each bureaucrat has to consider within implement a program. In this research, the top-bottom approach can provide effective details of the development that explore and the

direction of the administrative agency. Meanwhile, bottom-up approach help to reflect multitude of actors' involving in the program. Therefore, two approaches were implemented to study residents travel behaviour of developed area.

Travel behaviour has been mentioned in many individual studies to emphasize the relationship between the urban form and travel behaviour (Stead & Marshall 2001; Cao et al. 2009; Ewing & Cervero 2001 and 2010; Lefevre 2010). Over two decade many studies found that there is a link between build environment and the travel behavior. Mode choice and the length of the trip, connecting these aspects locate an approach to get a framework to design a safe community. Conversely, urban form can affect travel prices because it can influence the distance to different activities or by the different mode of the journey that chooses (Boarnet & Crane 2001). In addition, urban form and personal characteristics such as age, gender, norms, value lifestyle and social obligations can affect the transportation pattern such as trip frequencies, choices of destinations, and modes of traveling and trip route. Many studies still imply the concept of people choose their residence according to the influence of domestic location travel they take the demographic and socioeconomic variables in their conclusion. They imply a *Transport rationale*, which is all about the motivation and justification to use a certain kind of transportation to reach the desired destination (Nass & Jensen 2005, 165). On the other hand, *mobility view* that developed by Beckmann (2001) to includes the safety, comfort and aesthetic that all bring relationships between the private places and the travel in all level of urban context considering that people do not necessarily use the closet facilities. Still, the *distance decay* has a clear result in long distances to work that reduce the employment or any leisure activities. Because of some studies, people try to balancing between minimizing the travel distance and having the best facilities. They found that travel mode affected by two group of rationales; the efficiency of traveling and the process of movement, each group has many factors; the first group includes consumption, economic costs, and accessibility. The second group is a concern with the physical, psychological, and social aspects. Still these studies need to imply the term of sustainable urban form in different concepts and methods. Some studies found that It framed by two ways, compact cities and disperse cities and their relation with others variables such as the social, mobility, economy and ecology aspects. This will discuss widely in the literature review of this study.

1.2. Significance of the study

The importance of the study is that it should provide the richness of a case study scenario to underpin the impact of the social construction of the urban form and provide a significant understanding of urban form and its implications on the environment. This study tries to generate data, which will contribute to an understanding of how people attitude expectations influenced “lived experience.” On the other hand, it provides a basic tool to understand the travel behaviour of different level of the community as it will hold in the United Arab of Emirates. It has a variety of culture, religion and education background.

1.3. Aim and objectives

Based on previous knowledge and practical experiment, and preceding studies; the approach to sustainable urbanism is an urgent need to the development of countries; it reflects the level of civilization of nations. In this research, it will more focus on achieving holistic sustainable development practices to a neighbourhood so people could live at a decent life. The main issue here is the well-being of people and their condition whether it is psychological, social, and economic or even climatically comforts. This study is for find out *how people could live more sustainable at their place*. It focus on ***the relationship between travel behaviour and urban form and the affect of planning process on people attitudes***.

The aim of this research is to measure the effect of the urban form in people attitude and travel behaviour in micro planning development. To be able to accomplish the following objectives need to be achieved:

1. *To evaluate the main characteristics of a specific urban form.*
 - What makes or chape the place?
 - For which level does the urban form different from one city to another?
2. *To explore the relationship between urban form and travel behaviour.*
 - Is there any particular pattern that shapes the city?
 - Is there any correlation between the urban form and the mobility?
 - What is the best description of the urban form of the selected case study?
3. *To assess the current practice of travel behaviour in a neighbourhood scale for the study case.*

- Why applying a current travel behaviour assessment?
- Why do people travel? Why cannot people stay at home and telecommute or teleshopping?
- Where do people go? What is the destination?
- What are the effect of urban scale and travel behaviour?
- How is the urban form different from the older part of the city and the new one?

4. *To study the main parameters that affect implementing travel behaviour in the planning process.*

- Which of travel behaviour parameters have more influence in the urban planning process?
- Where changes in travel behaviour would be beneficial to society, how might those changes promote?
- What is the sequence or pattern of trips?

5. *To assess the current urban form to enhance the climatic condition to gain climate comfort.*

- To what degree and how do people rationalize the environmental and climate impacts causes by their travel?
- For how far could this relationship affect human climate comfort?
- Which of urban factors influence the climatic condition?

This research will have three stages to fulfil its objectives; first stage will study the urban form characteristics by studying a case study. Second stage will study the relationship between urban form and travel behaviour. Third stage will study other factors that affect travel behaviour.

1.4.study outlines

This research divides into five chapter, each chapter add detail reviews of the research in different level to provide further understanding of travel behaviour of different people in urban context.

Chapter 1: describes the subject of the research by presenting the objectives of the study, motivation and significant of the study.

Chapter 2: a literature review of sustainable development and its parameters, concepts of sustainable transportation and urban form. Reviewing travel behaviour in different perspectives with case studies and variety of experiences of travel attitudes.

Chapter 3: present the methodology of the research. Different approaches were implemented to study a particular case.

Chapter 4: presents the details of the study case, design process, results and analysis of different methods includes questionnaire, semi structured interview and simulation tools.

Chapter 5: represent the conclusion, recommendations and limitations.

In addition, a full appendix that contain of every method that used during the study includes questionnaire, semi- structured interview, validation of questionnaire and strategies diagram.

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2.1.Introduction

This chapter presents a literature review on travel behavior and its relation to urban form to gain a sustainable development. Many studies focused on their research on the existing sites to evaluate travel plans such as workplaces and schools. On the other hand, less research applying travel plans to new developments (De Gruyter, 2015) that need a higher concern from the developer and urban planner in the planning process. By taking the experience from existing and different land uses such as offices, schools, and universities, residential or retails, railways or airports and mixed-used developments. Table (2) presents different land uses with examples of related studies in travel plan and travel behavior field. It can be noticed that a variety of papers, researchers, and reports present travel plan and study travel behavior of the user within each kind of land use. Some papers investigated the impact of land use on travel behavior by implementing different methods. Such as (Volosin, 2004) study the student's travel behavior in the university, (Wiblin, 2010) exploration of the impact of travel plans on mix used area, and (Guiver & Stanford, 2014) investigation of the effect of tourism travel on the environment.

Table 2: Examples of different land uses with travel plans (De Gruyter, 2015).

<i>Land use</i>	<i>Travel plan study</i>	<i>outputs</i>
Universities and schools	(Volosin 2004)	Analyzing students travel patterns at Arizona State Univesity that vary from the rest of resident.
Offices and mixed used developments	(Cairns et al. 2010), (Wiblin 2010).	Study the impact of travel plans on residents, employees, and users of rose hill town center.
Residential sites	(Department for Transport 2008)	Provide transport solutions for new development to reduce travel trips.80 housing units is a suitable size to implement RTP (private travel plan).
Railway stations	(ATOC 2013)	give a comprehensive guide line of rail stations in the UK to provide advice on the proper practice of travel plans.
Sport events	(Currie & Delbosc 2011)	A review of the travel demand management program of the Olympic game in London 2012 with 20m (+30%) additional trips.
Tourist attraction	(Guiver & Stanford 2014)	The paper discusses the enhancement of visitor's travel while improving local and global environmental benefits.

Meanwhile, other researchers focused on giving facts that can help in planning and transportation for users. (Currie & Delbosc, 2011) studied the impact of the Olympic games in the UK, and the travel demand of this event. Also, Department for Transport in the UK give a minimum number of dwelling to gain a benefit from travel plan in 2008. This research will consider other experiences with different land uses then focus on the relationship between urban form and travel behaviour from morphological and useable sides.

the literature review provides objectives to cover through this chapter, To get the goals from this research:

- The element that controls any sustainable development.
- The relationship between urban form and sustainable development.
- Methods for evaluating the effect of urban form on travel behavior.
- Key success elements of the urban form to gain a sustainable development.
- Issues that are affecting travel plannings process.

2.2. Sustainable development

2..1. Definition

In 1987, a report on *our common future* published to find a link to economic development issues. The World Commission on Environment and Development (WCED) believes in the ability of people to build the future. However, these actions conditioned with political issues, so this report provide a pathway that could expand to ensure human sustainability (Brundtland, 1987). So sustainable development is a process of changes in all levels, investment, technologies and institutional roles to guarantee the present and future needs. The goal of sustainable development (SD) is the long-term stability of environmental, economic and social aspects (Emas, 2015). Capital is a concerning issue of sustainability. Weak or strong sustainable development can determine the level of capital. Weak (SD) concern of total capital of man- made or manufacture so that it can replace the natural capital. Nevertheless,

strong (SD) recognize the natural resources that cannot replace by manufactured capital (Stoddart, 2011).

The brief definition of sustainable development is “the ability to make development that meets the present needs without compromising the future generation’s needs.” That requires a participation of different stakeholders (W. Kates, and M. Parris, 2016). From another perspective, sustainable development can be described as “the kind of human activity that nourishes and perpetuates the historical fulfilment of the whole community of life on earth.” Therefore, SD is a dynamic concept that should acclimate with the changes of societies (Bossel, 1999). From an environmental aspect, the United Nations conference on environment and development in Rio de Janeiro, 1992 emphasized the need for protecting the environment by applying *Agenda 21*, that concern in presenting indicators of sustainable development to integrated environment and development system (Hammond and World Resources Institute, 1996). The main goal of SD is to enhance the human, economic, social and environmental system that make the communities healthier, productive, vital in the present, and future. People demands change rapidly, populations are increasing, and cities are expanding that make the need for implementing sustainable urban environment curtail. Communication and technology can play a significant role in sustainable communities by creating flexible options for work and shopping (Elkaftangui et al. 2014). Measuring the sustainable development process in communities is one of the most important stages to ensure the success of the process. It can be measured by observing five outcomes of the process. These five outcomes are, increased skills, strengthened relationships, and improved initiative and provide healthy and diverse economies (Elkaftangui et al. 2014).

2..2. Dimensions

To implement sustainable development in communities, it should have three main dimensions that work together and in balance to achieve the goal of sustainable development (Bawa and Seidler, 2009):

- Economic: the sustainable economic system should maintain productivity, control, and balance. Therefore, it can offer goods and services in a way balance with the natural resources and control the external debt.

- Environmental: sustainable environment system can maintain the stability of resources, by avoiding the utilization of renewable resources and depleting of non-renewable resources. Therefore, it preserves biodiversity, ecosystem functions, and atmospheric stabilization.
- Social: sustainable social system focus on people. Therefore, it should fulfil distributional equity, public participation and offer basic social services including health and education.

These three elements add more potential and conflict relationship to the definition. It considers a multidimensional goal, by balancing different aspects such as balancing between providing food and water that required changing in land use and the harmful effect on the biodiversity. On the other hand, sustainable development has many complications to get the balance between the objectives and success measurements. Therefore, how can we avoid trade-offs in the real world between these different potentials? Richard Norgaard points out that we can maximize one objective at a time. *“It is impossible to define sustainable development operationally in detail and with the level of control presumed in the logic of modernity.”* (Norgaard, 1994). Nonetheless, if this tripartite goal can achieve, then the world would be better. It could be easier to recognize unsustainability to gain the motivation to take necessary policies (Rosenbaum, 2014).

2.3. Urban Form

2.3.1. Definition

Urban form refers to the term “physical environment” including large, small and permanent objects such as streets, buildings, rivers, utilities, hills and even trees (Lynch, 2001). Urban form is going beyond these separate elements to include the relationships between these objects in a hierarchy view of the city. That control the level of the resolution (Oliveira, 2016). Nevertheless, these relationships are affected by different terms include land use, quality of material, owners (single family, public housing, field, busy street), spatial distribution that can be presented on two-dimensional maps such as topography, land use, street or utility, description of population, densities, traffic, statistics, economic activities and so on (lynch 2001).

All of these terms correlate to generate a form of the city. The level of goodness of this form depend on the strength of these relations.

From the morphological view, Cities consist of some relationships with the hierarchical view that result in urban tissues (Oliveira, 2016). This tissue is observed in different levels according to the degree of resolution. A higher resolution means more details of urban form elements. For low resolution, urban tissue consists of streets and blocks.

On the upper level of resolution, it has more information such as building or construction materials. The real relationship between these elements can offer a unique character of the cities. Time factor plays a key role in shaping cities, as all cities are the result of the long construction process. Oliveria in his book, *urban morphology* (2016) analyzed eight different cities at the same scale of urban tissues to demonstrate the various urban tissues of the towns. Figure (1) shows these cities.

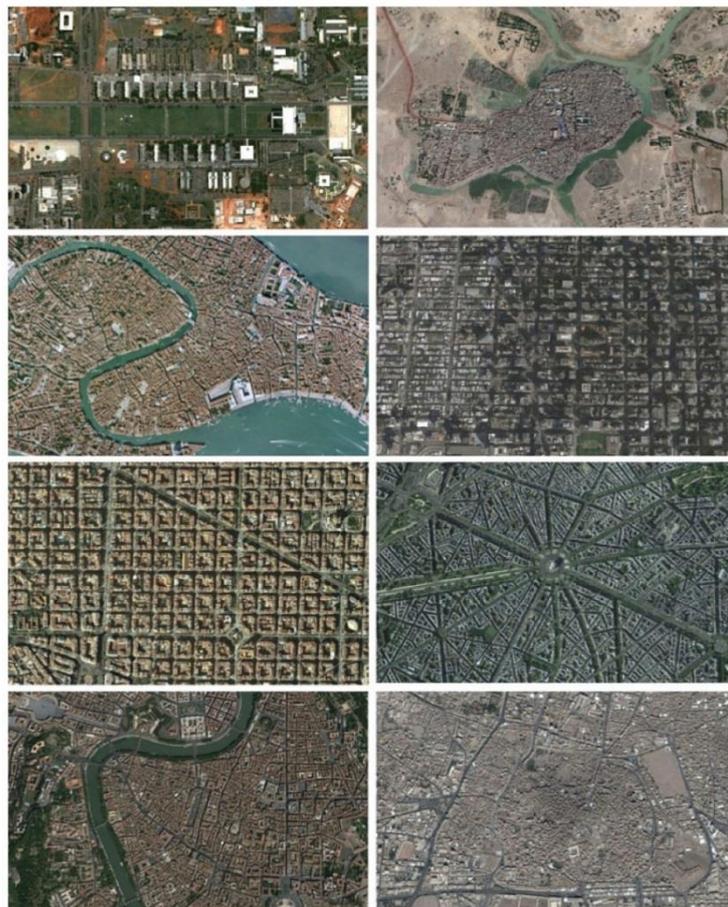


Figure 1: Different tissues of eight cities ordered from left: Brasilia/Brazil, Djenne/Mali, Venice/Italy, New York/USA, Barcelona/Spain, Paris/France, Rome/Italy, and Sana'a/Yemen (Oliveira, 2016).

Brasilia shows a high relationship between open space and building area. Djenne with the clear central built up area surrounding with vacant areas. Venice, with extreme compact urbanism and dominant of water feature. New York, with a highly regular pattern of urban tissue. Barcelona, with the regular grid. Paris, with the radical street form and uniform alignment and height. Rome, with a very dense block and small street with some squares. Sana'a, with a clear relationship between built and vacant areas (Oliveira, 2016). This different form in these cities give a clear example of the time factor in shaping the cities. It shows continues process with different dimensions that control the process.

2 3.2. Dimensions

The degree of performance of the city determines by its reflection of biological, psychological, social and cultural demands of its residents. The level of satisfaction will offer the degree of city goodness. In this term Kevin Lynch in his book, *good city form* (1981) put the dimension of performance that determines the good city: validity, sense, fit accessibility and control (Downs and Stea, 1973). Figure (2) shows the five parameters of good city form.

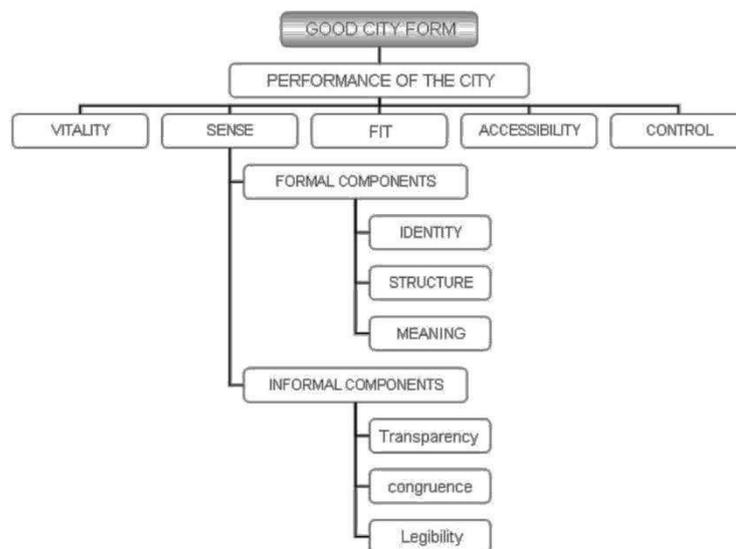


Figure 2: Good city form by Lynch's theory (Downs and Stea, 1973).

- Vitality: it is the degree of provision of essential, biological of the human being as water, air, energy, and food. Also, the community should be safe.

- Sense: it is the degree of the relationship between physical city and observer. Therefore, it depends on spatial structure, culture, quality, and purpose of the monitor.
- Fit: It is the degree of relationship between function and physical city. This dimension is more related to the culture as it reflects how much the spatial and pattern matches the behavior of its residents. Fit means feel comfort.
- Accessibility: it is the degree of reaching to all things such as transportation, services, Information, other places or other people. It offers choice and diversity to residents.
- Control: It is the degree of controlling the environment from the people. Control can give the feeling of power and stability. Also, this happens when there are enough social and physical spaces.

In *our built and natural environment* (EPA, 2013) addresses the direct effect of urban form on the environment and ecosystems. In addition it affects travel behaviour that in turn affect pollution, land use climate and noise (Jabareen, 2006). Jabareen in his paper identified four sustainable urban forms. By implementing different ideas and concepts for each type. Table (3) shows a different kind of various ideas and examples that used in his research.

Table 3: Different approach for sustainable urban form (Jabareen, 2006).

Sustainable urban form	concept	approach
Compact cities	High density and compactness	Mixed used-new urbanism
Eco-city	Urban greening- ecological and cultural diversity- passive solar design	Environmental management and policies
Nontraditional development	Sustainable transportation-diversity- compactness-mixed use and greening.	Working with the style and design coding
Urban containment	containment policies	greenbelts, urban growth boundaries, urban service areas

Jabareen (2006) found that sustainable urban form could be achieved by different approaches using different scales and concepts. Therefore, he suggested seven design concepts that reflect the Variety between the four sustainable urban forms. These concepts include density, diversity, mixed land use, compactness, sustainable transportation, and greening and ecological design. The study provided a sustainable urban form matrix to help in assessing urban forms in term of sustainability according to the previous design concepts. this matrix concluded that the sustainable urban form

is high density, adequate diversity, mixed land use with compactness and has a sustainable transportation, greening and passive solar energy. Moreover, sustainable urban form tries to achieve different objectives such as decreasing energy use, reducing automobile use, reducing waste and pollution, preserving the open spaces and sensitive ecosystems and providing liveable community- oriented human environments.

There are five elements that characterized cities; density, housing building type, layout, land use, and transport infrastructure. These factors influence sustainability and human behaviour (Jenks and Jones, 2010). It is important to study these elements separately and it is clear that these items should be integrated with each other. Accessibility is closely linked to the density. When planning a new residential area, housing type and size can be affected by the density. Figure (3) presents these five elements.

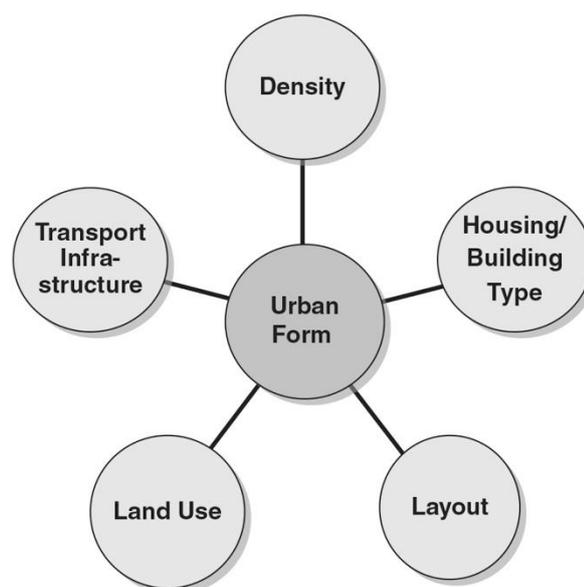


Figure 3: Urban form elements (Jenks and Jones, 2010).

As a conclusion, urban form is influenced by many parameters, historical, cultural, economic, environmental and social- life style. Each urban form in any different cities has its own identity with its characters. However, this form needs to be at the optimum level by keep controlling different parameter and its relationships.

2.4. Urban form meets the goals of sustainable development

2.4.1. Introduction

As shown from a literature review of the urban form section. The Urban form can affect sustainable development in term of economic, environmental and social. The sustainable urban form can achieve if it based on global sustainability goals with a local solution (Jenks and Burgess, 2009). Jenks and Burgess (2009) in their book *compact city*, recommend taking advantage from other countries best practice in implementing urban sustainability. They give examples from different cities, Curitiba city /Brazil is a good example to using power in controlling development by restricting local policies to restrain car use and link different public transportation. South Africa and Brazil have a good experience in economic level by implementing taxes to the developers for infrastructure provision or developing vacant land. In contrast, by giving developers incentives when using floor area ratio or compact development. The sustainable urban form is changing concepts, so many concepts and new theories should experience and emerge. It needs the resources and confidence to express new theories.

Coppola et al. (2014) gives a comparative example of three different urban forms: compact, TOD, and sprawl to give practical insights into the relationship between urban form and sustainable development. They found that different urban forms could affect urban development differently. Compact development has the better influence by scoring the highest value for public transportation use, and commute trips that made on foot. In addition, it presents the less land consumption and less CO₂ emission. However, it increases urban congestion level and dwelling prices that affect the social alienation and segregation. Handayanto et al. (2017) studied two kinds of urban forms: compact city and eco-city based on four criteria: suitability, compactness, compatibility, and dependency. They found that the combination of different kinds of sustainable forms is more reliable to achieve sustainability. Accessibility and connectivity from different points on the street to a destination need a homogeneous land use distribution that prove the validity of mixed use and compact city to shorter travel distances. In addition, it affects the travel choice by increasing walkability for shorter distance ((Doig, Gayah and Cassidy, 2013)

To achieve a sustainable urban form, many components need to imply Such as density, shape, size, compactness, land use, mixed use, the layout of the building and solid –void relationship. These components are considered as a starting point of the cities to be compared to (Jenks and Burgess, 2009).

2.4.2. Sustainable Transportation

Traveling method has a huge influence on sustainability. It affects the environment in different level, by affecting the social life when increasing car use and maximize the congestions and noise, or more air pollution from vehicle emissions, or harm the ecosystem by increasing fuel consumption. Moreover, motorized transportation rises safety, health, congestion and traffic issues (Al-Atawi, 2015). Spatial planning and urban form affect mobility. Many types of research studied the impact of urban form on the sustainability of the cities as (Jabareen, 2006; Jenks and Burgess, 2009; Coppola et al., 2014; Handayanto et al., 2017). These works were explained in details in the previous sections (2.3.1, 2.3.2.). However, these researches and more demonstrated transportation part in explaining the relationship between sustainability and urban form.

The vitality of involving the land use with mobility set up in the City of Vancouver's former Planning Director Brent Toderian who rightly states; "*the best transportation plan is a great land use plan.*" (Toderian, 2013). Bill Hillier, the founder of Space Syntax, expressed the important of streets when he said, "*social differences have no expression on streets.*" In addition, he argues that livability of streets is the most relevant indicator of the presence of strong civil society (Hillier, 2009). From the morphological and temporal perspective, the street system has the greater resistance to change or transform. Plots system (land distribution) is coming to the second level of stability; it can change according to different factors (legal or personal) by the time. Building system (construction) has the lowest durability over time; it can change more quickly than the two first systems (Oliveria, 2016). Therefore, to achieve a sustainable transportation, it should meet the needs of users by three sustainable pillars; economic, social and limited the environmental impact (Al-Atawi, 2015).

On another research, sustainable transportation required three main concepts; accelerating action, bridging barriers and choosing values (Leiserowitz et al., 2006). Accelerating action is the need to increase the action of choosing more sustainable solutions. Bridging boundaries happen when considering the attitudes of individuals and convert it into behaviours, e.g., gender equality. Choosing values means recognizing and highlighting the differences between personal values systems, e.g., choosing between clean, expensive fuel source and cheaper and harmful one. Williams (2005) in her book, *Spatial Planning, Urban Form and Sustainable Transport* addressed many definitions to sustainable transportation term. She found that all of these definitions agree with the providing an essential requirement that meets the social, economic mobility needs, it should be accessible, affordable and safe. In addition, it refers to the environmental impacts, in the two aspects, operational terms and avoiding pollution.

Choice of routes is influenced by urban layouts that also affect the cost and efficiency of the network. The more grid pattern, the more choice of routes. The more tree pattern like cul-de-sac means less choice of routes. Figure (4) shows different layouts of roads (Jenks and Jones, 2010).

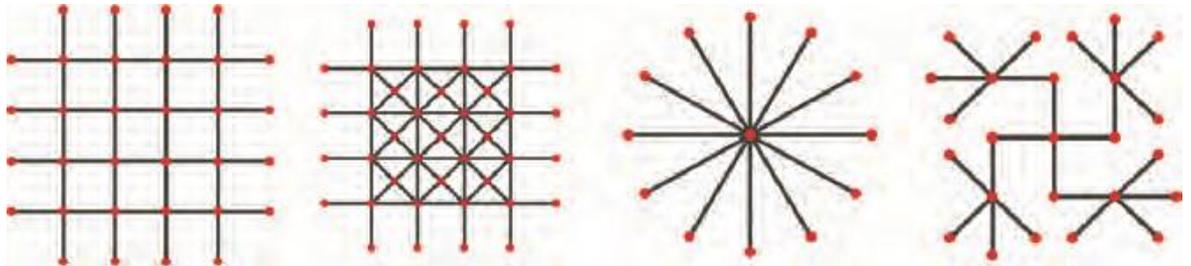


Figure 4: Different urban layouts (Jenks and Jones, 2010).

Moving toward sustainable transportation need a relationship between satisfaction and environment. Still, it has constraints such as limited facilities, inconvenience, low quality and long waiting time (Bachok et al., 2014). Amiril et al. (2014) in their research addressed the central performance of sustainability of transportation infrastructure projects. The study reflects these parameters to include sustainable practice strategies that can help project manager, planners, designers, and decision makers to improve their plans. Table (4) summarize the main parameters for each pillar of sustainability.

Table 4: Sustainable parameters of transportation infrastructure projects (Amiril et al. 2014).

Theme	Sustainable parameter
environmental	Minimize pollution & environmental impacts A balanced development Community/public acceptance Protect native/aquatic wildlife Meeting waste management standards Maximizing rainwater harvesting and re-use Reducing carbon footprints and energy use Protection of water quality Prevention of land contamination and degradation Air quality and dust suppression Noise and vibration minimization
economic	Fit for purpose & quality Minimize maintenance & operation cost Minimization risk Completion on time
social	Protect cultural heritage Save travel time & vehicle operating cost Public acceptance Open & transparent community involvement Promote interagency collaboration Safe construction Public acceptance Minimize health & safety risk Better decision making Clear term of instruction & approval within time
Engineering/resource utilization	Enhancement of infrastructure life span Achievement of project objectives Long-lasting & high-quality products Saving maintenance cost Uninterrupted material supply Reduction cost Increase design innovation Minimization waste
Project administration	Completion on time No dispute Achieves client's objectives

2.4.3. Examples of GCC sustainable transportation experience

The Gulf Countries Council (GCC) has the most rapid population and economic growth since oil discovery. Now it considers one of the most developed areas with high standard of living. This development rises the concern about the sustainability and environment for mega structured developments. This concern has seen in the most of the GCC policies and future agenda (Jawad, 2013). The transportation sector has a

high concern beside other sustainable initiatives (MASDAR initiative, ESTIDAMA Pearl Rating system in Abu Dhabi). The road and transport authority (RTA) in Dubai is planning to launch buses that exclusive for women (Belwal, 2013). Implementing integrated transportation system such as Dubai metro. In 1998, Dubai was the first who ask for traffic impact studies (TIS) in the region for developments over than 100 trips/peak hours (Jawad, 2013). In addition, it found a manual for trip generation and parking rates with nine different land uses. Bahrain launched a public private sector joint venture, 2008. By adding 350 fleet of cabs to the existing. Qatar presented an initiative of launching electric powered taxi and battery buses in 2008 (Belwal, 2013). Nowadays, cities go toward smart development and cities by applying different concepts. Dubai RTA develop smart parking strategies, Smart Dynamic Traffic Monitoring and Information Towers (SDTME) in Abu Dhabi to provide information and used for traffic management and using weather sensor and CCTV technologies (Surface Mobility, 2017). GCC rail 2021 project, that connect UAE, Oman and Saudi Arabia by offering a health, safe and secure to the society. It is expected to carry up to 16 million passengers per year with an efficient, comfortable and more environment friendly mode (John, 2017).

2.5. Travel behavior

2.5.1. Introduction

Despite the extensive presence and deep understanding about environmental and sustainability, yet it does not reflect in individual travel decisions. Most of the projects that focus on sustainable mobility have fully or partly failed. Because sustainable mobility needs changes in individual travel behaviour (Nasrudin, Rostam and Noor, 2014). 50% of climate impact is because of long distance travels (Reichert and Holz-Rau, 2015). The most constrains of behavioural changes connected with the hypothesis of additional efforts decrease the comfort (Nasrudin, Rostam and Noor, 2014). Therefore, that makes the car more reliable, convenient, and secure with the ability to access different destinations and with more privacy. Another constrain is the verity between the short-term perspective of individuals and long-term perspective of society that make conflict between their interests. Also, the social values that were given from using a private car like skills and competence or cultural restrictions for women in Arab countries for their moving or mixing with male that result a social

exclusion, beside the low price of petrol in the region (Al-Atawi,2015). Nevertheless, the negative environmental effects and the need to enhance the preserve of cultural heritage location should adapt sustainable solutions in different levels, planning, travellers, and policies of energy use and so on to reduce this negative impact (Nasrudin, Rostam and Noor, 2014).

2.5.2. Theoretical background

The majority of papers focus on the car or public transportation as a mode of travel; little articles discuss pedestrian or cycling activities separately like (Cao & Mokhtarian, 2005). Therefore, most of these papers have two main question in travel behaviour term. The first one *can urban form and land use influence travel behaviour*. Such as (Cervero, 2002; Guiliano, 2003; Handy, 2005). The other question is *which socio demographic factors appear to influence travel behaviour?* (Best & Lanzendorf, 2005), Such as gender, household, composition and income habit and car ownership. On the other hand, some studies discuss in depth the role of the *self-selection* in travel mode and frequency. This will reveal that if people are choosing their travel mode according to self-believe and philosophy on transportation and the environment (Curtis & Perkins, 2006). *Self-selection problem* can affect the residential location according to the preferred travel mode. Nass (2009a) demonstrates the essence of urban structure to travel behaviour. It can affect people self-select in the areas that match their travel manners.

- **urban scale**

Aditjandra et al. (2013) presented the impact of neighbourhood design on travel behaviour by getting ten different neighbourhoods. They define two types of neighbourhood for their study, a traditional neighbourhood and suburban (new) neighbourhood. The study based on a self-administered questionnaire for 2200 households of the two neighbourhoods. Moreover, it focused on four parameters: neighbourhood design, socioeconomic variables, and travel pattern and travel attitudes. It found that land use policy with the target of low carbon based travel neighbourhood would be more effective in the traditional group. However, it found that the residents in the traditional parts have a desire to travel further if they are given the opportunity. Even though they have the best choices than others. Another study discusses the influence of urban form and pattern of travel behaviour in the Nordic

countries. Also, more studies carried out in wider international context. It focuses on urban land use- geographical distribution, the density of building and public function. It provides some examples of Nordic countries to control the amount of transportation by controlling land use, which makes these countries, focus on a citywide, on the contrast with many American studies that emphasize the neighbourhood-scale (Næss, 2012).

A few studies addressed the relationship between the local street pattern (grid structure or another street pattern) and travel behaviour. Nass (2011) found no effect of the local street pattern and travel behaviour when controlling the locations, demographic and socioeconomic variables. Westford (2010) studied the influence of street pattern on the walkability of children to the school. He found that children have a low propensity to walk within three adjacent neighbourhoods when the urban network has a grid street system and mixed traffic.

- **location**

The influence of location stressed on the socioeconomic and demographic variables as control variables while the ownership and attitudes should exclude. That based on the study of Copenhagen metropolitan that found the weekday traveling distances from suburban areas are four times the traveling distances from whom living nears the centre of the city. The total difference of travel distance tends to be larger in the large city than the smaller (Nass, 2009a). Moreover, there is an apparent relationship between the urban density and energy use (Nass, Sandberg & Roe, 2007), higher frequency among Swedish municipalities contribute a lower energy consumption for transportation even when controlling other variables (income and population size). Even the evidence that residential locations near the centre can reduce the traveling and car use. Nevertheless, this can provide on the metropolitan and city scale. However, in the regional level centralization may not benefit as the same of metropolitan scale from the perspective of energy use and emissions. At Copenhagen metropolitan area, it found that a slight reduction in traveling distances for more than 45 km away from the centre (Nass 2009a). However, in the study of three Danish countries, Nass (2012) found that an increase in the travel distance by increasing the distance from home to the centre of the nearest town within 15-25 km but the motorized travel decreases if the distance increase beyond this level. This

result can point to *distance decay*, so most of the people tend to orient themselves in a smaller range and more local areas even the opportunities and facilities are limited.

Local area density in the Nordic countries of residential areas has not that important in the studies except when relates to other variables such as the location of other activities. The studies show a correlation between the local area density and travel behaviour by controlling the demographic and socioeconomic variable with no influence of the location of dwellings from the centre. Once the last variable involved in the studies the effect is vanished (Holden & Norland, 2004) and in a small Danish town of Frederikshavn (Nass & Jensen, 2004). For greater Oslo, Nass & Sandberg (2007) found a high tendency to travel by transit among employees of the workplace in the high-density areas. That presents the importance of the work location about the city center. Instead, (Engebretsen, Hanssen & Strand 2010) found a high level of car use to the shopping malls in exurban. So according to the Nordic studies, there is a strong effect of the local area density around the workplace and shopping malls. A few studies of cities have spotted the impact of the workplace location on the travel behaviour (Nordic cities as example). These studies found a lower percentage of using own car and higher proportions using public transit, bicycle and foot especially for the inside workplace job (Monsen 1983; Hanssen 1993; Martamo 1995; Nass & Sandberg 1996; Hartoft-Nielsen 2001b; Strommen 2001; Nass 2007b). Hartoft Nielsen (2001b) demonstrate that the use of car increase from 40-45 percent to 80 percent at the workplace when the distance was 30 km. Some new planning theory believed that by relocating the workplace to the suburban areas is shorter commuting distances of car trips. There is no prove of such tendency. Instead, a slight increase of commuting trips when locating the workplace in peripheral areas (Hartoft-Nielsen 2001b; Strommen 2001). Therefore, the proper commuting distances are 10-25 km from the city centre according to (Nass 2007b). However, Martamo (1995) in Helsinki found that the commuter distances affected by the job location to the Main Street outer suburban or inner suburban. Still the commuting distance decreased when the distance to the centre increase beyond 20-25 km.

Goudie (2002), found in his research of 408 households in Townsville and Cairns that location is the most important part in fuel consumption and travel distances. Participant from suburban location used fuel three times more than the central location of the city, but the suburban had the least sustainable travel behaviour.

Another study by Giuliano & Narayan (2003) for travel behaviour in British, and US it found that the land use patterns of US make people to use more vehicles because of sprawling areas.

- **Urban design**

Study for Cervero (2002) in Montgomery county, he studied the relationship between new urbanism and travel modes. He used a normative model that focus on three dimensions, density, diversity and design. He found that the density and mixture of land use had a significant influence in travel mode. He found the higher densities could lower solo commuting, also, he found that work destinations with higher density could produce a higher use of public transportation. The author did not discuss the urban design issues but it found that the sidewalk ratio could be the most variables that affect travel modes. Another factor that affects the traveling distance is the scale of cities

Descriptive analysis evidence that the neighbourhood design influence travel behaviour. In this case, the traditional neighbourhood had better travel and accessibility than a suburban neighbourhood. Which gives a good view of new policies in changing travel behaviour, also land-use policies should be more aware of the differences between drivers in different urban form. From another side, even the residents of the traditional neighbourhood had a better accessibility, but they had a higher desire to travel further than the suburban neighbourhood did. Aditjandra, (2013) suggests for future studies to continue with the multivariate analysis with examining causality with isolating the effect of people choice self-selection. Also, it recommends including the physical built environment measurement such as distance, facilities, district shopping centre density, pedestrian accessibility (Aditjandra et al., 2013).

2.5.3. Criteria for influenced travel behavior

There are four variables to determine travel behaviour according to Stern's framework; *personal capabilities* that presented by knowledge, time, money, social status and power of the individuals. *External factors* include social, physical,

economic and political variables. *Attitudinal factors* consist of environmental and non-environmental attitudes, values, personal norms, and beliefs. *Habit* means the way of the act without considering the behavioural choice. The last two factors classified as psychological variables (Eriksson, 2008). These variables can guide the way of measuring travel behaviour in any community.

The focus of this research is about external factors especially, *urban form* of the communities. The main factors that affect travel are the reasons for going to a place, the cost, and inconvenience. So urban form can change travel prices because it can influence the distance to different activities or by the different mode of the journey that chooses (Kim and Brownstone, 2013). Moreover, urban form and personal characteristics such as age, gender, norms, value lifestyle and social obligations can affect the transportation pattern such as trip frequencies, choices of destinations, and modes of traveling and trip route. High population density implies shorter average distances and more frequent public transport departures and shorter walking distances to these stations; furthermore, the street will be narrower and less space for parking. Usually, the accessibility by public transport is highest in the centre of the cities.

Many studies still imply the concept of people choose their residence according to the influence of domestic location travel they take the demographic and socioeconomic variables in their conclusion. *Transport rationales* are all about the motivations and justification to use a particular kind of transportation to reach the desired destination (Næss & Jensen 2005). On the other hand, *mobility view* that developed to includes the safety, comfort and aesthetic that all bring relationships between the private places and the travel in all level of urban context considering that people do not necessarily use the closet facilities. Still, the *distance decay* has a clear result in long distances to work that reduce the employment or any leisure activities (Næss, 2012). Therefore, some studies present that people try to balancing between minimizing the travel distance and having the best facilities. They found that travel mode affected by two group of rationales; the efficiency of traveling and the process of movement, each group has many factors; the first group includes consumption, economic costs, and accessibility. The second group is a concern with the physical, psychological, and social aspects. Accessibility is one of the most important factors that encourage people to use transportation mode, Leonard Cheshire, 2007 found that 67% of disabled people in the UK choose public transit more often if there is more

access to it. Other kind of studies should be included, which is longitudinal studies that concern on the time order. It uses a dynamic analysis work more with the individuals and circumstances of people, their attitude changing with time and circumstances. Such as when people move from one form of living to another (Handy *et.al.* 2005).

2.5.4. Countries experience in the role of travel behavior

EU's white transport paper sets goals by 2030 to shift to cleaner vehicles, reduce the use of the conventional car by half, and by 2050 shifting to electric vehicles, hybrid cars, hydrogen cars, and increase the use of public transportation and walking/ cycling in the cities. UK's 2011 white paper state that transportation is the engine of economic growth, and its emphasis on safer and greener societies. These visions come true by encouraging public transportation, especially for short trips. UK Sustainable Development Commission (SDC) finds that 84% of total trips are less than 10 miles. That gives a high potential for public transportation (SDC, 2010). From economic development, transportation industry employs 10 million people in the UE (European Commission, 2011). Smarter travel Sutton 2010 initiative London, have a good experience in changing travel behaviour by focusing on schools and workplaces by giving personal travel advice, advertising marketing campaigns and as a result, reduction in car trips by 9% per person. Moreover, 10-22% increase in bus trips per person, 26-30% increase in cycling trips per person and 13% increase in walking. These numbers increase by the next year by more focus of the campaign. Another example, city of Ghent/ Belgium. It makes 'making cycling normal' they make the priority for the cycling, distinct cycle paths. These initiatives help in reducing congestion and more access to city centre. Brittany-France improve taxi network (taxi tube) with facilities to link rural areas (Howarth and Polyviou, 2012). California, US designed railroad square that matches LEED-ND. That create 180 jobs with 300 kW photovoltaic array. The location of this development in the centre of Santa Rosa that gives the developer a high opportunity in the existing community rather than promoting sprawl (Farr, 2008).

Aditjandra et al. (2013) study travel behaviour in Tyne and Wear, UK. It found from the descriptive analysis evidence that the neighbourhood design influence travel behaviour. In this case, the traditional neighbourhood had better travel and

accessibility than a suburban neighbourhood. Which gives a good view of new policies in changing travel behaviour, also land-use policy should be more aware of the differences between drivers in different urban form. From another side, the study demonstrates that even the residents of the traditional neighbourhood had a better accessibility, but they had a higher desire to travel further than a suburban neighbourhood did. The study suggests for future studies to continue with the multivariate analysis with examining causality with isolating the effect of people choice self-selection. In addition, it recommends including the physical built environment measurement such as distance, facilities, district shopping centre density, pedestrian accessibility. Rouse Hill town centre, Australia give a good example of travel plan initiatives such as information centre, green travel club and promotions of travel of multiple users. These initiative take place in 2011 (Ho et al., 2015).

Chapter 3: Methodology; analysis and results.

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3.1.Introduction

The aim of this study is to measure the social behaviour of people during their travelling and its impact on urban form. Many methodologies can be used in this discipline, according to the aim of each purpose and the limitation, the available equipment, time issues and the cost. The study is about evaluating the micro-climate comfort at urban context according to people attitude to their travel behavior. Mixed mode methodology used by combining qualitative and quantitative methods. More studies conduct an extensive literature review for each part of the research; by applying a full details for travel behavior; its definition, parameters, and benefits for individuals and communities. For urban form, the definition, dimensions and the advantages of this aspect, also details to micro-climate comfort strategies; its aspects, benefits and its variables that can be used to evaluate neighborhood, and comparing with the existing data from the measured data from the site. Collecting data from the field and the competent authorities, quantitative methodologies like questionnaire survey for private people and visitors for this location, analysing data conducted by many tools, site analysis for the selected neighbourhood, climate analysis, spatial analysis, regression analysis, and threshold theory. The comparative method applied to evaluate a good example that has a successful experience with travel behaviour strategies and measure strength and weakness of their experiment. The simulation method conducted by UCL depthmap and ENVI-met software.

This study has two main methods; collecting data by using several approaches; survey, semi-structured interview, primary and secondary data analysis, studying similar case study. Simulation by using UCL depthmap and ENVI-met software to add more reliability to the study.

3.2. Collecting data

The most important part to have a sustainable transportation is to observe people attitude and their behaviour to using a different kind of transport. Thus an excellent survey can help to understand people behaviour and demand; it allows planners to explore how and when people move and what influences and motivates them to choose different modes of transport. The questionnaire can take different type according to the parameters that need to reflect on the size of the studied area. There are many ways to perform a survey; the attitudinal survey is a series of attitudinal question in statement form to answer with agree or disagree on five or six level, it called a Likert scale. It used to provide specific data on household characteristics. Focus group is another kind of survey to understand more about the selected factors; it usually consists of six to twelve persons who answer the question according to their experiences and attitudes. Personal interviews can give the same richness in responses as focus groups; it is a flexible tool to collect specific data with more opportunity to have clarification and explanation from the respondent (Ritchie and Lewis, 2014). Some studies used semi-structured interviews to get a comprehensive data of daily life, in other studies they used travel diary that give the same detailed data for individual situations. The participant-observer method is another way to collect specific data by spending a day or more with the participants traveling trips to explore the concomitances that make people change their schedules of choices (Handy et al, 2005). It can be in the local neighborhood, or regional level cope, Motherwell, and Gois, (2015) studied the regional scale of Edinburgh city to measure the volume and the type of journey people make. The study conducts a face-to-face survey with 1195 residents' age (+16) in 95 areas. Moreover, a seven day of travel diary for the household. The representative sampling approach gave a general data about the age, gender, work nature, and ethnicity. Whereas, proportional sampling was more detailed and specific with 17 wards. For travel diary, 1121 diaries received. It asked them to record their trip for seven days and gave a certain data such as the purpose of the journey, starting location and their destination, the mode that they used the distance and the timing of their trip with considering each trip separately. A total number of 12944 trips recorded. *Segment analysis* was adapted to measure the behaviour; it consists of six frameworks that can group the people according to their attitude. The paper discussed the attitude of individuals toward transportation types such as

walking, cycling, and public transport. Also, it focused on the trip information. The confidence is usually 95%.

Aditjandra, Mulley, and Nelson (2013) presented the impact of neighbourhood design on travel behaviour by getting ten different neighbourhoods to define two types of neighbourhood, traditional and suburban. They used a self-administered questionnaire for 2200 households, and focus on four parameters: neighbourhood design, socioeconomic variables, travel pattern and travel attitudes. The type of the neighbourhood used factor analysis, multivariate analysis, and regression analysis to study each parameter and find out the most important factors that influenced. Another kind of studies included with longitudinal studies that concern on the time order. It uses a dynamic analysis work more with the individuals and circumstances of people, their attitude changing with time and circumstances. Such as when people move from one form of living to another Handy *et.al.* (2005).

The purpose of the survey is to measure travel attitude of people according to their built environment, based on Government's Economic and Social Research Council (ESRC) online survey (Geography.exeter.ac.uk, 2009), Maher (2012), Aditjandra, Mulley, Nelson (2013) and De Gruyter (2016) studies. Some questions modified to be more engaged with the purpose of the study. Table (5) shows a comparison between these studies and this study's survey.

A semi-structured interview is another tool to collect data, but in this case, it targets a small group of respondents with more valid questions. It adds validation to other information that derived from other resources. It is a flexible and powerful tool as a qualitative research method. It leaves a space to the participant to add a new meaning and value to the study. It is a combination of theoretical part of a study with well organize perspective, and a contextual narrate influence (Galletta, 2012).

Table 5: survey methods and details (author).

Authors	Year	Objectives of survey	Methods	Details
Government's economic and social research council (ESRC)	2009	Gauge the attitudes and opinions over a wide range of travel and transport issues that concern Exeter, Devon and the UK, and it is part of a massive research project into travel and transport in Devon by the University of Exeter.	Online survey with a representative of our team will collect it at an agreed time.	The survey had eight sections, types of travel that used, the environment, the attitudes towards travel, information about travel and transport, attitude towards transport policies, changes in travel behaviour, about household and further comments. Questions about Holiday's travel, detailed questions about environment attitude in lifestyle, detailed questions about household members and some travel policies eliminated because it is not on the target of this study, for policies it quite different about this study country.
Maher	2012	To have the attitude of people about the criteria to build smart cities based on TOD approach.	Questionnaires for 299 participants as a sample size in Gaza city.	The survey had four sections, general information, trips, and transportation means, walk and using public transport and transportation network, services and land use. The similar questions with other studies, questions with relevant facts or existing circumstances because of different policies of countries were eliminated.
Aditjandra, P., Mulley, C. and Nelson, J.	2013	To provide a descriptive analysis It divided into five sections (travel pattern, built environment characteristics, preferences of travel, change in travel patterns and socioeconomic characteristics).	Used a self-administered questionnaire for 2200 households. Also, factor analysis used to elicit the statements.	The survey had five sections, (travel pattern, built environment characteristics, preferences of travel, change in travel patterns and socioeconomic characteristics). The similar questions with other studies, and travel patterns questions eliminated.
Cope, D., Motherwell, S. and Gois, J.	2015	The attitude of people toward transportation types. It relies on a study that holds on University of Aberdeen (ICM (2014) Edinburgh Travel Behavior Survey [unpublished] ICM, London), and facilitated a workshop with the colleagues in Sustains and Edinburgh city council.	Face to face survey with 1195 residents age (+16) in 95 areas. Moreover, a seven day of travel diary for the household.	This study gives questions and topics that discuss in the workshop. It consists of 38 questions. The similar issues with other studies, questions with relevant facts or existing circumstances because of different policies of countries were eliminated.
De Gruyter	2016	To examine the scale of travel planning practice for new developments in Victoria-Australia.	Self-completion questionnaire. Administered online to 36 councils.	This study consists of 19 questions. The similar issues with other studies, questions with relevant facts or existing circumstances because of different policies of countries eliminated.

To conduct a semi-structured interview some points, need to prepare and take into consideration; good selection of interviewee type, careful creating of the interview questions, try to record the interview and reporting the results (Rabionet, 2017). This study relies on two semi-structured interviews from two studies, Maher (2012) and De Gruyter (2016). Table (6) demonstrate the main common questions that help in this study.

Table 6: Semi-structured interviews methods and details (author).

Authors	Year	Objectives of semi-structured interview	Methods	Details
Maher	2012	To have the attitude and policies of agencies about the criteria to build smart cities based on TOD approach.	Twelve interviews with professionals who work in the field relative to planning development topics.	The semi-structured interview had ten sections, Introduction, Definition, Overview about the current situation, Supporting the proposed approach, the importance of the new approach, the impediments and challenges facing the development process and the new approach, Corporation, Financial issues, Education and promoting awareness, New ideas. The similar questions with other studies, questions with relevant facts or existing circumstances because of different policies of countries eliminated.
De Gruyter	2016	It is an excellent method to achieve the research objectives. It spread all over a wide geographical area in Victoria.	An online survey of 36 out of 79 councils. To find out the scale and characteristics of travel planning in Victoria, Australia.	This study consists of 11 questions. The similar issues with other studies, questions with relevant facts or existing circumstances because of different policies of countries and some eliminated.

3.2.1. Survey

The survey starts by dividing the topic into two titles; built environment and travel behaviour. Then identifying the main factors in each title that need to investigate by this survey. For built environment characteristics, accessibility, safety, environmental awareness, attractiveness and spaciousness, outdoor spaces and activities and socio-economic factors. For travel behaviour characteristics, travel time, safety, public transportation, car use, walking, cycling, and using alternatives. Each subtitle has some points to cover by the survey as it shown in the hierarchy charts below. By adopting these factors, built environment section has 18 statements to cover and travel behaviour need to 17 statements to answer. This survey conducted on 14th of June 2017 by applying attitudinal methods; Likert scale with combination with

personal interviews. Also, it has a dichotomous and multiple-choice question to get comprehensive responses from different sections of people.

Population and Sample Size

The study conduct in Sharjah city in UAE, in one district (Muraija) with a total population of 6351(Sharjah census 2015), the specific location called the heart of Sharjah. Sample size determined by using Glenn (1992) study. A 95% confidence level and margin error of .05 for ± 10 percentage precision levels assumed to calculate the sample size.

Survey design

The survey starts with a covering letter to explain the purpose of the study, the aim of the research and the security of the information. The survey includes attitudinal methods; Likert scale with combination with personal interviews. Also, it has a dichotomous and multiple-choice question to get comprehensive responses from different sections of people. The survey consists of five sections to cover all the factors that suggested at the beginning of the study. (See appendix for full survey).

- A. General information with five questions.
- B. Trips and transportation with five questions.
- C. Environmental awareness with seven statements.
- D. Transportation and urban form with eleven statements.
- E. Travel attitude with seventeen statements.

Pilot Study

Before collecting the results, a pilot study was conducted to a sample group as a trial run for the survey. It tests the easy understanding of the questions, clear purpose of the survey, the way of collecting data, and the patient of respondents to answer the questions. The pilot study presents 20% of the whole study to use also on the validity of the survey later on.

3.2.2. Semi- Structured Interviews

Semi-Structured Interview Sample

Since this study has a complete survey for the selected location, semi-structured interview aims to provide more accurate information that reflects decision-making opinions, idea, regulation of the city in transportation issues and more over the vision of this agencies to the future. Therefore, the selected group is professional who work in a specific field that related to transportation. Four semi-structured interviews conducted, two of interviews carried out with the directorate of town planning and survey, and interviews held with road and transport authority, another one undertaken with Sharjah urban planning council.

Semi-Structured Interview design

The semi-structured interview starts with a covering letter to explain the purpose of the study, the aim of the research and the security of the information. The semi-structured interview includes with open-end questions, dichotomous and multiple-choice questions and applying attitudinal methods; Likert scale to get comprehensive responses, and to meet the aims of the study. It consists of six sections to cover all the factors that suggested at the beginning of the study, (See appendix for full interviews):

- A. Introduction
- B. Definition
- C. Overview of the current situation

- D. Design elements

- E. The challenges facing the development process

- F. Corporation

3.3.Simulation

Using computational simulations are one of the important methodologies in most of the research field. Simulation can help to predict relationships among variables by analyse suggested situations; it can proof the possibility of certain behaviour. Alternatively, discover unexpected parameters or scenarios. In addition, it can explain the process of behaviour or phenomena, or criticize theoretical explanation proposed by other researches in addition it can suggest different scenarios or method with complex environment (Harrison, et al, 2007). Simulation by computer considered an economic and simple method comparing with other methods by applying virtual models of the real environment (Peter Briglia, 2014).

In term of transportation, simulation can be used in different level with varying objectives. Traffic models have a widespread use in a hundreds of research papers that presented at 93rd annual meeting of transportation research board in 2012 (Lieberman, 2014). Li et al. (2006) used simulation model to study the impact of pricing on passenger travel behaviour, the authors' make two models one of the demand (travel behaviour) and interaction model by linking the demand with the supply. Starting with performance matrix to determine the supply of train operation and demand of passenger travel. Then they generated a travel behaviour model based on the passenger choice model developed by MIT and several airlines and railway survey. This model is suitable for policy evaluation and system performance. To validate their simulation, they compare the performance matrices from their simulation with ones from actual network. Jiang et al. (2016) work on stating an urban motility without using a travel surveys. They present TimeGeo, a modelling that use mobile phones tracking information. By finding an origin destination (OD) matrices to estimates a person trips within pairs of ODs; a validated result in different cities can obtained in few hours. To realistic the data it need a population distribution at different times and a big data resources. So high resolution travel diaries that tracking a large sample of users based on their Information and Communication Technology (ICT). TimeGeo considers the spatial distribution of land use. By testing scenarios of how the change in land use pattern will affect travel. It is offering flexible tools that provide different

scenarios by using population density and distribution of facilities in urban context. Blokpoel and Joueiai, (2016) present using SUMO (simulation of urban mobility) to study bicycle traffic in both cases slow as car or fast as pedestrian. The speed of bicycle can be influenced by many factors such as critical density, maximum lane capacity or jam density. The width of the bicycle lane affects capacity; for example: 1 m width can carry 1200 bicycle per hour, meanwhile; 3 m width can increase the capacity to 3200. In SUMO, these parameters integrated to determine the best scenario for lane cycle. In addition, SUMO can model cycle movement as faster pedestrians. Taking in consideration intersection topology. Because of the model, it gives an accurate data for delay time of vehicle, and balance between the capacity and traffic density. SUMO presented in another paper that focus on motorway segment by using single vehicle data. Barthauer and Friedrich, (2016) present this in SUMO 2016-traffic, mobility and logistics proceedings in Berlin. As SUMO can simulate real vehicle's driving behaviour. SUMO started by identify the traffic characteristics, then build a road network and added a traffic flow. Simulation's outputs correspond well with single vehicle data measures that had been taken from traffic management system.

Many transportation studies in Berlin proceedings 2016 validate simulation software. Richter et al (2016), present Openstreetmap (OSM) software. Moreover, it found that this simulation can be a data source but it cannot fulfil all the requirements. Chraibi et al (2016) present Julich pedestrian simulation (Jupedsim) that analyse pedestrian motion in microscopic environment.

Overall, table (7) summarize the methods that used in the research by giving the opportunities and limitation of each method. Moreover, the table linked between the objectives and the method by giving the suitable research instrument.

Table 7: Research methods (author).

<i>Method</i>	<i>objectives</i>	<i>Research instrument</i>	<i>opportunities</i>	<i>Threats and limitations</i>
Survey (quantitative)	<ul style="list-style-type: none"> To evaluate the main characteristics of a specific urban form. 	Questionnaire	<ul style="list-style-type: none"> It is easy to administer. Need less time to develop. The ability to collect data from a significant number of respondents. Flexibility in asking and data analysis. A broad range of data and questions. 	<ul style="list-style-type: none"> Not sure if the respondents encourage to answer. Not sure if the respondents aware the target from the questions. Disability to provide more information. Need a high attention to questionnaire design.
Interviews (qualitative)	<ul style="list-style-type: none"> To explore the relationship between urban form and travel behavior. To study the main parameters that affect travel behavior in the planning process. 	Interview guide	<ul style="list-style-type: none"> Useful to gain further information. Capturing non-verbal participant behavior. Useful to explore data in depth. 	<ul style="list-style-type: none"> Take more time to conduct, analyze. Manual entry of data Potential of the interviewer to ask. Potential of the participant to answer. It considers an intrusive for the participant.
Secondary data analysis (quantitative)	<ul style="list-style-type: none"> To study the main parameters that affect travel behavior in the planning process. 	Data analysis technique/program	<ul style="list-style-type: none"> Saving time, consider a fast tool. Consider less expensive tool Does not need more activity to perform. 	<ul style="list-style-type: none"> Difficulty in data access. The quality of data may not control. Data may not adequate the bias of data
Case studies* (qualitative)	<ul style="list-style-type: none"> To evaluate the main characteristics of a specific urban form. 	Case study protocol	<ul style="list-style-type: none"> Provide an example of the study. Provide in depth experience. More confidence in research data. 	<ul style="list-style-type: none"> Time-consuming to study the cases. Bias in data. Hard to generalize in some cases.
Simulation (qualitative, quantitative)	<ul style="list-style-type: none"> To assess the current urban form to enhance the climatic condition to gain climate comfort. To assess the current practice of travel behavior in a neighborhood scale for the study case. 	Software analysis	<ul style="list-style-type: none"> Results have a high reliability. Help in finding new trends and phenomena. Easy to perform. No need for hard activities. 	<ul style="list-style-type: none"> Need an experience to perform. Usually, it is expensive to have a software. Time-consuming in building a model and conducting the results.

*consider as approach more than method, but include in the table for completeness

3.3.1. Space Syntax stimulation using Depthmap software.

Space syntax theory introduced in the 1970s by Steadman. after a year, a book with name “social logic of space” was published by Hillier and Hanson. Space syntax is an approach for socio-spatial aspect by using descriptive, quantitative and analytical tools in urban or architectural scale. To understand the social parameter that shape space (Kamalipoura et al., 2013). Space syntax is considered an effective means to predict human movement by local integration to improve the urban environment (Liu et al., 2015). Unlike conventional ways of analysis such as shorter path, which presented by algorithms and it is not satisfying on large network graphs space syntax imitates the natural motion of a human in an urban context (Vartholomaios et al., 2014). Space syntax has four factors that help to investigate the social parameters to measure the accessibility of the space: connectivity, control, choice, and integration. On the other hand, three analysis systems used axial, convex and isovist. (Kamalipoura et al., 2013). Many studies all over the world focus on space syntax approach in trying to interpret the social function into spatial characteristic in the existing public space to improve their accessibility (Önder and Gigi 2010; Talavera 2012; Koohsari et al. 2013; Khan 2014). Accessibility is very important concept when studying spatial characteristics, so it is with high connect to space syntax theory. Accessibility can express the ease of natural movement from point to another point in the space (Hillier et al., 1993). Other studies utilize space syntax approach to explore the influence of spatial configuration to the visual perspective, Mahmoud and Omar (2015) studied the influence of plantation o the visual perspective in an urban park. Hoeven (2014) evaluated the way finding, visibility and orientation in urban underground space in metro station.

Space syntax uses many software applications to present a spatial model (Hillier, 1996). Depth map, Confeego, Spatial Positioning Tool (SPOT) and WebmapAtHome (Turner, 2007). Also, many plugins that connect to other software to analyse spatial configuration. Spatial positioning tool (SPOT) based on isovists to analyse the space, and it presents graphs of the distributions in the space. It is more concern in the visibility phenomena. However; this tool work as a prototype and not complete software (Turner, 2007). webmapAtHome is a stand-alone software developed by Dalton on angular analysis (Hillier, 1998) but still, it supports other software to make

export/import processing easy for the user (Turner, 2007). Many studies implement this software on its work (Osmond, P. (2011), Sadek and Shepley, (2016)). Webmapathome is not supporting segmental analysis; it is an axial capability that gives it the ability to analyse the axial angular integration (Dalton et al., 2005). Depthmap is the most significant visible graph analysis (Hillier, 1998). It considers a multi-functional, stand-alone software that can operate in any system that makes it an easily access from users. Many studies rely on depthmap software (Varoudis et al.2013, Schick et al.2013, Kamalipoura et al.2013, Vartholomaios et al...2014, Mahmoud and Omar 2015). Alasdair Turner at University College London developed DepthmapX software, in 1998. It considers the most popular application for studying space syntax with more than five thousand users (Varoudis et al., 2013). (Ramadanta et al, 2012) used space syntax to study urban contoured landform by studying the topography and movement path that connect different activities. (Kamalipour et al, 2013) study the impact of environmental design on preventing crime. The study conducted an axial map and VGA analysis to verify the results and evaluate the case study. (Mahmoud and Omar, 2015) study the influence of spatial by planting tree in urban parks by using space syntax theory. Space syntax can represent the urban area as a matrix to connect the spaces. This method can help assess the effect of planting tree on social structure.

3.3.2. Microclimate thermal comfort using the ENVI-met software.

ENVI-met is a Computational Fluid Dynamic (CFD) model that simulates a full built environment surface air based on the fluid dynamics and heat transfer fundamentals (Tariq, 2014). ENVI-met developed by Michael Bruse in 1995 (D'Souza, 2012). Runs on Windows and UNIX system. It developed from fluid dynamic and thermodynamic laws (Chow, 2011). That based on micro-climate model by calculating the temperature in interval range from 24 to 48 hours, this calculation based on a grid system with a specific distance between them (Hien et al., 2012). It broadly used in urban climatic researches Chow et al., (2010) studied the influence of vegetation on UHI in phoenix, Arizona through observations and simulations. The study generates two residential areas with different vegetation by using ENVI-met software. It supposed different scenarios. Low, medium and high xeriscaping. It found that the ability of low water shade trees of reducing UHI is notable. Elnabawi et al.,

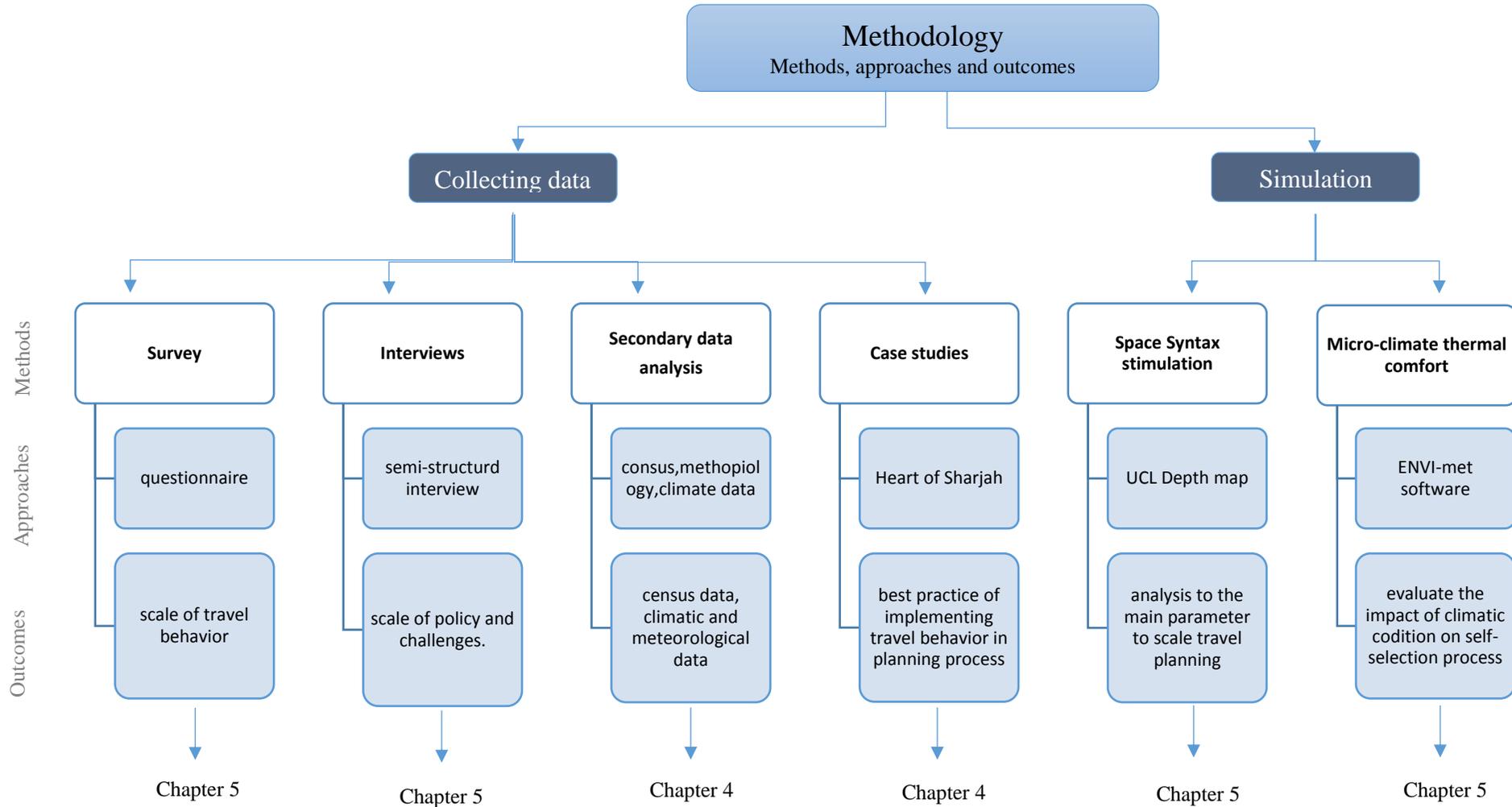
(2013) on the other hand used ENVI-met software to study outdoor thermal comfort. He select Cairo,Egypt to model his case study by taking two different urban form. The study present a validation of ENVI-met result by comparing it with on-site measurments and represinting Tmrt and PMV maps as an important step to measure thermal comfort. As a result EVI-met shows a good approximation with temperature measurment, humidity results. But in Tmrt results, both ENV-met and site results are adjacent till sunset, ENVI-met result drop down as there is solar energy, the study provide similar study for Toudent and Mayer (2006) that found similar result that Tmrt of ENVI-met underestimated at night time. Middel et al., (2014) study the impact of urban form and landscaping on climatic condition on mid-afternoon time during summer months. He selects Phoenix, Arizona as a case study. By using weather observations from North Desert Village data and designing five different urban form of neighbourhood scale. It follows Local Climatic Zone (LCZ) in classifying scenarios. ENVI-met model worked for 24-48h for June 23, 2011. Validation of ENVI-met was with comparing the result with observed data, which shows similar trend with slight different. It found that compact development may have benefits to sustainable urban development, but it increases UHI effects. Mid to high building with a good orientation of wind flow and sun direction can reduce daytime temperature so sustainable development is not a smart growth but also a smart design. In addition, the research recommends using LCZ concept and ENVI-met as a powerful planning tool. Manteghi et al., (2016) investigate in using water body in microclimates to cool buildings or urban spaces.by using ENVI-met to analyse temperature distribution based on evaporation from water and vegetation. Case study was Malacca city centre. The simulation run for 24h by applying different scenarios with or without water or vegetation. It found that water and greenery could strongly cool the surrounding. Moreover, the best cooling was achieved by vegetation that lower the temperature by 0.3C.

To implement ENVI-met simulation, it needs a specific area with a dimension (height and width), soil or surface or vegetation type in this field with a certain scale of the grid cell (Chow, 2011). ENVI-met has most of CFD algorithms such as energy and moment equation, model navier Stoke equation and atmospheric flow turbulence. It has more advanced specialist than CFD as it applied a numerical model for plant, soil, air, and surfaces (Toudert et al., 2005).

Validation of ENVI –met can be done by two ways; governmental and organization credential, and researchers used of the software in their studies or comparing the results that they received from on-site observation to ENVI-met result or comparing ENVI-met results and ability with other software. For first part, ENVI-met authorized by many environmental agencies such as EU-project BUGS, Housing, Spatial Planning and Environment (Ministry of VROM), The Dutch Air Quality Innovation Program (IPL), and Public Works and Water Management (Rijkswaterstaat) (Elnabawi, Hamza, and Dudek, 2015). For the second part, all of the studies that mentioned in the previous part about EVNI-met compare their data with ENVI-met results. Hien et al. (2012) compare temperature prediction in Singapore by using two models, Screening tool for estate environment evaluation (STEVE) and ENVI-met, to study the benefit and limitation of each models. It found that resolution of ENVI-met map is more details than STEVE models. Roset and Vidmar (2013) evaluate three simulation tools, ENVI-met, Vasari and IES V-pro in term of urban form in two parts: functionality and usability. In the conclusion of the research, it found that there is no one tool can cover all urban analysis but ENVI-met can apply more detailed analysis that make it the most suitable model for real case. In usability, Vasari can be steps in than other tools. IES VE-Pro in single building analysis can win, but in urban scale, it comes at the last rank with other two applications. Kittas et al. (2015) used experimental data to validate ENVI-met to predict the effect of different kind of planted pergolas on the microclimate environment. On site, measurement carried on a hydroponic pergola at Kostakii campus Arta, Greece by using three sensors for temperature and relative humidity parameters (HD9008TR; Delta Ohm, Padua, Italy). Meanwhile solar radiation measured by a solar pyranometer (SKS 1110; Skye Instruments, Powys, UK). In addition, it depends on a microclimatic data from weather station. It takes 4 years to carry on the evaluation. These sensors record a measurement every 30 s. ENVI –met proves the ability to imitate the real word. Help to reduce the time of measurement comparing with the time that it need to study any phenomena.

Figure (5) summarize the research structure by presenting the map of research methods and expected outcomes.

Figure 5: Research methods, approaches, and outcomes (author).



Chapter 4: Results and discussions

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4.1.Introduction

This chapter demonstrates the potential of the results based on the methodology that stated in chapter 3. A comprehensive analysis of the selected location, the strength, and weakness of the area, climatic, potential, historical and site analysis of land use, and network analysis. These analyses give deep understanding to the case study with more details that can be essential in simulation process later on. In addition, data of population, demography provide an aid tool in preparing the survey and determine the scoop category of the study.

The survey and semi-structured interview results is shown in this chapter by using SPSS software, with inputs of 98 surveys and five interviews. The outcomes of this surveys and interviews demonstrate the attitude of respondents in travel trips. Software simulation by using ENVI-met and UCLdepthmap present the potential of the site in the different time of the day. In the field investigation, collecting data from the site by using Extech 45179-4 in 1 environmental meter. Also considering climatic data from climatic consultant tool to use in ENVI-met software. Some data were collected from authorized agencies such as land use, and network map to use it in UCLdepthmap software.

4.2.Background and context of the case study

4.2.1. Urban structure of the location

Case studies “generate rich subjective data, can bring to light variables, relationships, and processes that merit further investigation and provide good stories, human interest and a more humanistic method of delivery compared to the quantitative method” (Burns, 1994). In keeping with other approaches in qualitative research, the case study “aims to understand the situation in depth, and in its natural setting, recognizing its complexity and its context. It also has a holistic focus, designed to preserve and understand the wholeness and unity of the case. Therefore, the case study is more a strategy than a method” (Punch, 1998:150). Heart of Sharjah considers an excellent case study to evaluate travel behavior with different urban form. It is a combination of conventional and modern form with mixed use, different height, and various network. UAE is the most developed countries in the Arab world with a diverse culture, demographic

and socioeconomic variables and considered a modern example in this case. To analyze the context, a site analysis and historical background for location are obtained to understand the properties and parameter of the site.

Sharjah is the third largest Emirates with a total area of 2600 sq.km. It has a unique location with diverse geography. It is considered a gate for the East Emirates and has a superb water-front as shown in figure (6).

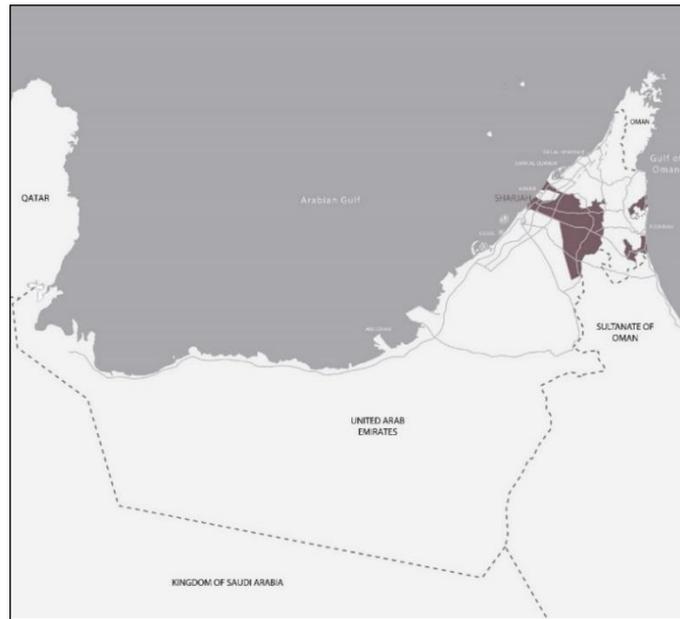


Figure 6: Location of Sharjah. (SDTPS).

According to the Google Earth maps shown in figure (7) with interval period of 17 years (2000 - 2017). Many changes occurred to the location; the Cornish change from a commercial port to water front. Also the central part has been modified from car parking to a central park then at 2015 changed to a recreation centre.



Figure 7: Evolution of the case study 2000-2017. (Google earth).

This place is one of the most historical places in Sharjah city; it contains an old fort (al hisn) which has been converted into a museum. The Fort was built in 1823 and as a government headquarters, a resident of ruling family (Sharjah museums.ae, 2017). Bait Al Naboodah is another museum that was constructed in the mid-19th century. Some markets (Souq) located there, e.g., Souq Al arсах, Souq Alshanasiyah, Souq Saqr, Old Souq. Moreover, many heritage places that were converted to be used as a museum or art school or even a traditional hotel (Agency, 2017). Sharjah investment and developing authorities work on four stages project in the location to maximize the value of heritage places. The project will extend to 15 years. Stage 1 concentrates on the renovation of the existing places as shown in figure (8). Moreover, adding new facilities and services that attract tourism to this location.



Figure 8: stage one of the heart of Sharjah project (Agency, 2017).

Stage two try to emphasize on the walkability through space by considering bus stop, water bus, taxi, and car parking. Figure (9) shows stage two and the link between water-front and the central Park of the neighbourhood.



Figure 9: stage two of the heart of Sharjah project (Agency, 2017).

The third stage is about to construct a new infrastructure that homogeneous with the heritage of Emirates by lowering building height and finding new cafés and restaurants as shown in figure (10).



Figure 10: stage three of the heart of Sharjah project (Agency, 2017).

The fourth stage as shown in figure (11) is the final image of the project with the renovation of whole neighbourhood and linking the project with the central Park to emphasize on walkability. This development need time and money to implement. This study investigates on the attitude of people toward this kind of development. That why this particular location was selected since it has this future development plan.



Figure 11: stage four of the heart of Sharjah project (Agency, 2017).

The project-finished stage one until now, Figure (12) shows the journey footpath through the location in stage one starting from Souq Al arsah passing by Alshanasiyah ending with Souq Saqr. Although the high temperature, the place gives an experience of shopping or resting in one of the café and restaurants, that encourages walkability through the place.



Figure 12: journey footpath through a different kind of Souq (Agency, 2017).

4.2.2. Demographic profile

In 2015, the department of statistics and community development in Sharjah emirate conducted a census of the population of Emirate of Sharjah. The results showed that the city of Sharjah housed 90.6% of the total population of the Sharjah emirate (1,274,749 people out of a total population of 1,407,326) as shown in Figure(13) the population percentage of the different city of Sharjah. The main concentration in Sharjah city with the highest percentage of 90.6%.

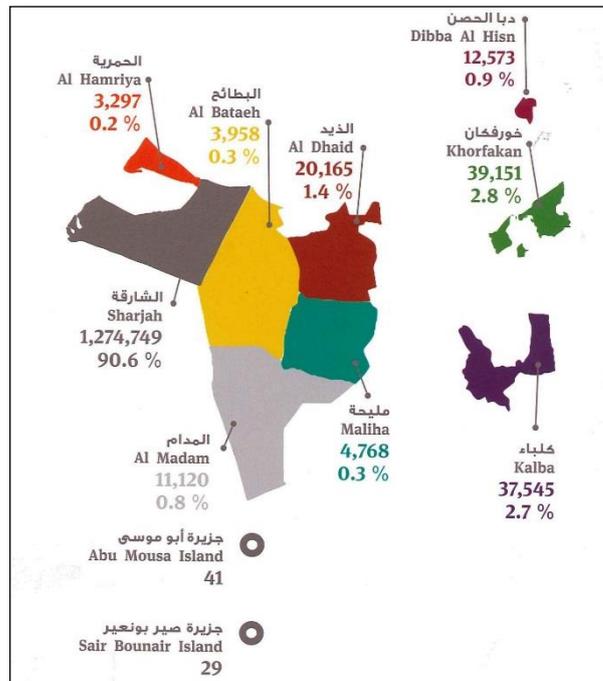


Figure 13: Total population of Sharjah emirate (Sharjah census 2015).

The number of the male population is 920,867. That translates to 65.5%. The city is considered a youth community, the most of the emirate's population aged between

الإجمالي Grand Total	أنثى Female	ذكر Male	فئات العمر Age Group
111,035	53,807	57,228	0-4
96,990	47,029	49,961	5-9
70,960	34,300	36,660	10-14
61,095	30,157	30,938	15-19
121,608	41,087	80,521	20-24
242,915	68,447	174,468	25-29
247,395	69,541	177,854	30-34
157,895	48,872	109,023	35-39
108,244	31,430	76,814	40-44
74,092	20,818	53,274	45-49
30,777	9,845	20,932	55-59
16,581	5,969	10,612	60-64
8,796	3,831	4,965	65-69
4,318	2,052	2,266	70-74
2,565	1,346	1,219	75-79
1,213	623	590	84-80
688	360	328	85-89
342	182	160	+90
1,681	624	1,054	غير مبين Not Stated
1,405,843	484,973	920,867	الإجمالي

25-35 years. As shown in figure (14).

Figure 14: Age Group in Sharjah emirate (Sharjah census 2015).

Moreover, most residents are workers and employees with a high percentage compared with another employment status.as shown in figure (15).

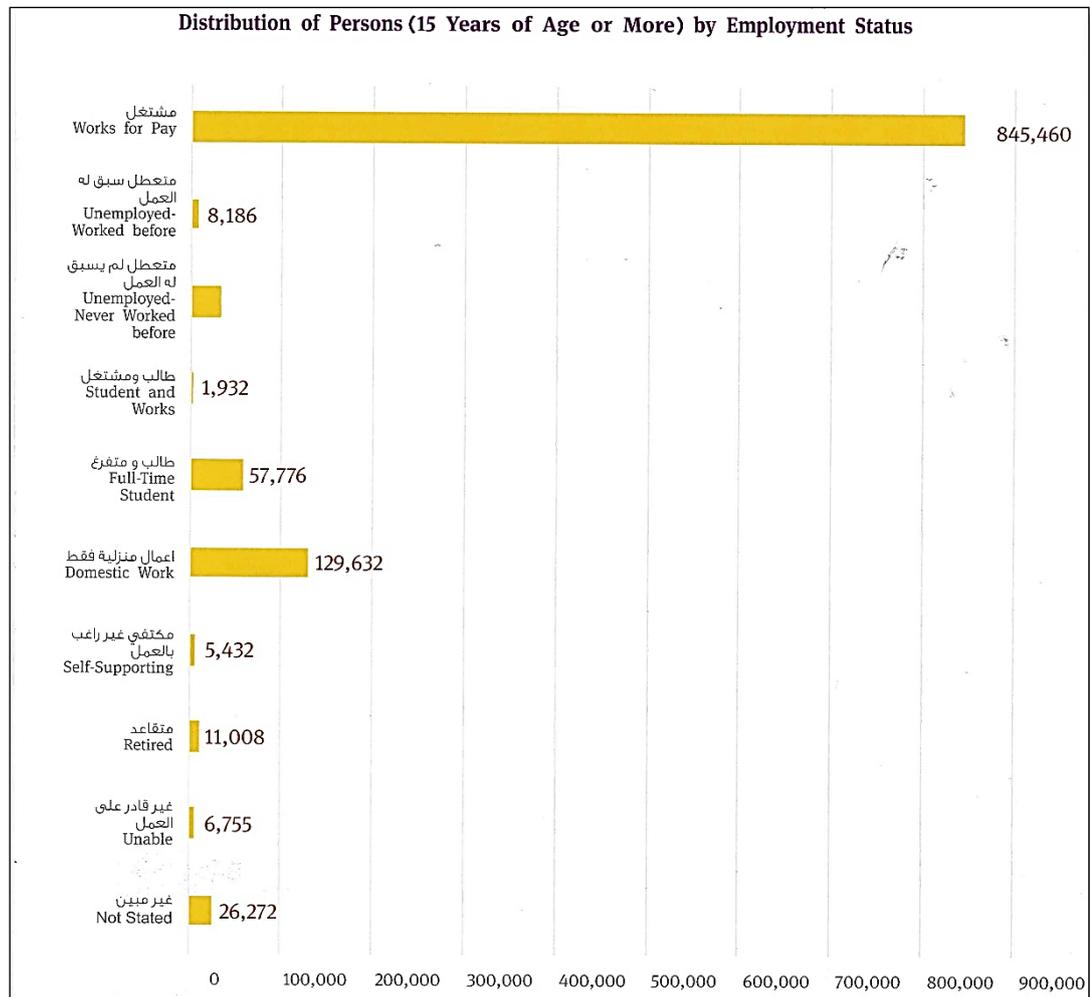


Figure 15: Employment status of residents (Sharjah census 2015).

4.2.3. Site analysis

This level of analysis consists of wide range of maps and diagrams that illustrate the understanding of the urban context of the selected location. The analysis on the neighbourhood level and it concentrates on the network and transport issues with considering the land use and climatic analysis.

Figure (16) shows the access points to the selected area from main roads and other neighborhoods located between two neighborhood (Murija and Shuaheen). It has many access paths from these two regions and has the main access from the main road (Cornish road) which connect Sharjah city with Ajman. From the side, the location has another access from highway road (Aruba road) which consider a vivid road at the city.

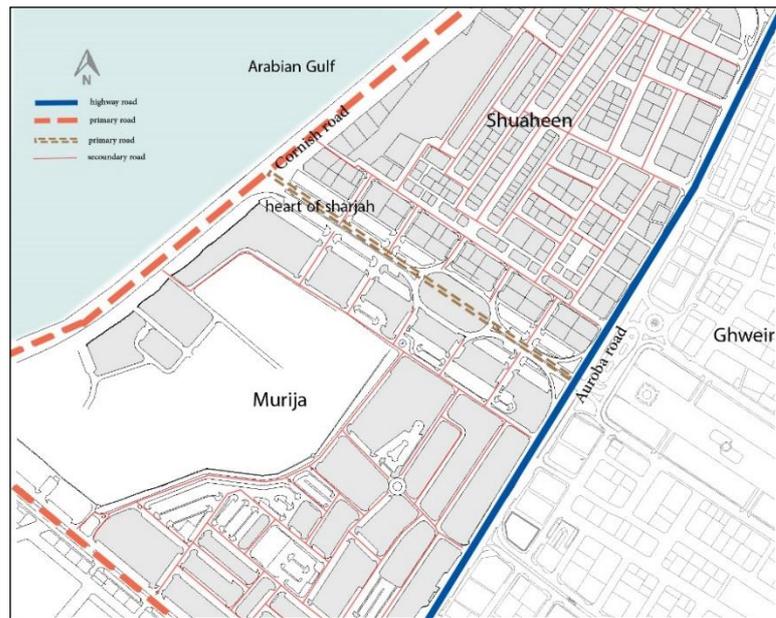


Figure 16: road accessibility from the main road (author).

Figure (17) illustrates road network and hierarchy of street to the selected area. The roads have a different width from 6 m to 40 m.

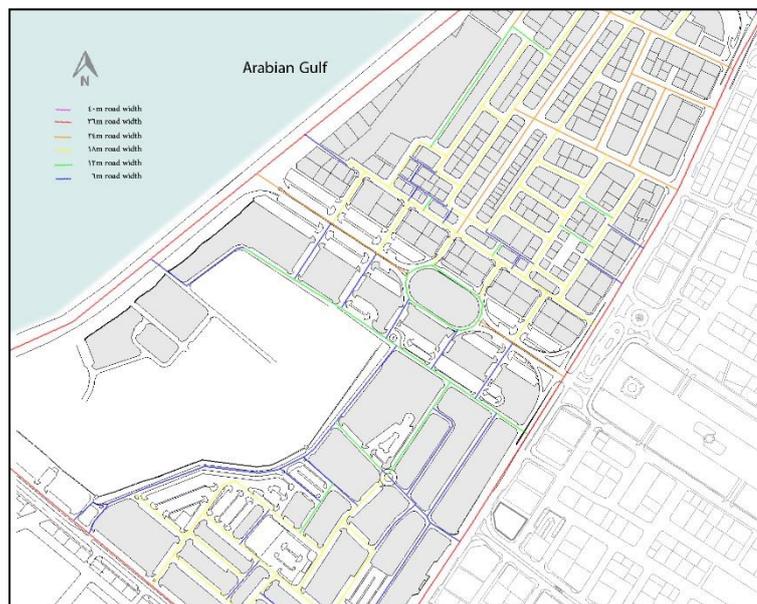


Figure 17: Road network analysis (author).

The location has a distinct use, and it has a significant area with a heritage use. The general characters of the place are commercial purposes with a traditional type. Also, the height varies from three floors to twelve floors. Figure (18) shows the land use of the location.

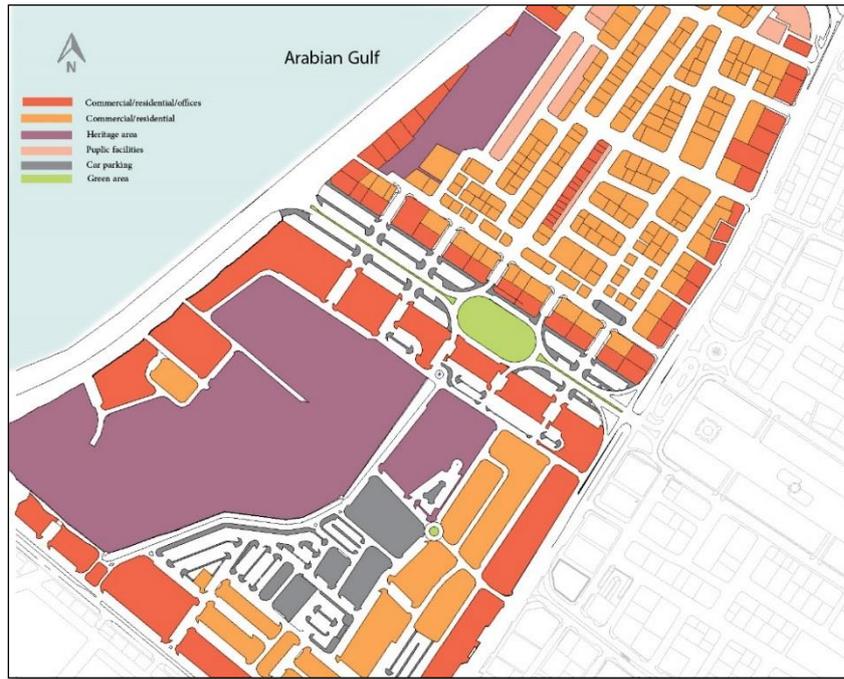


Figure 18: land use (author).

The selected location is part of the whole area. It is like a corridor that divides the space into two parts with a good view and uses to the place. Figures (19-22) show the elevations and the urban form of the selected location.



Figure 19: north-eastern elevation (author).



Figure 20: southwestern elevation (author).



Figure 21: Northwestern elevation (author).



Figure 22: southwestern elevation (author).

Figure (23) shows the sun path and wind direction on the site. Sharjah weather reflects an arid subtropical climate with two major seasons, a hot summer, and slightly more mild winter. Summer months occur between April and October with high humidity. Winter in Sharjah is comfortable with high temperature and lasting between November and March. For the wind, figure (24) speeds in Sharjah, in general, are a high and important factor in thermal comfort. Prevailing winds come from the north western (the water side) in the morning a smooth breeze directed from the south-eastern side. These prevailing winds can employ to facilitate natural cooling and creating a comfortable environment. Wind planning and creating of wind corridors through the build and planted windscreens or corridors to build thermal comfort.

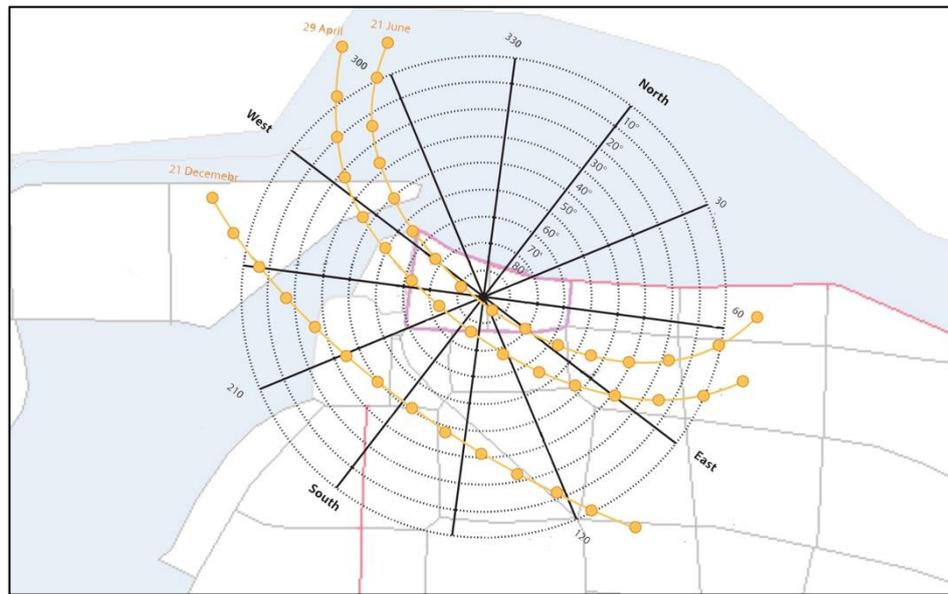


Figure 23: sun path and wind analysis.

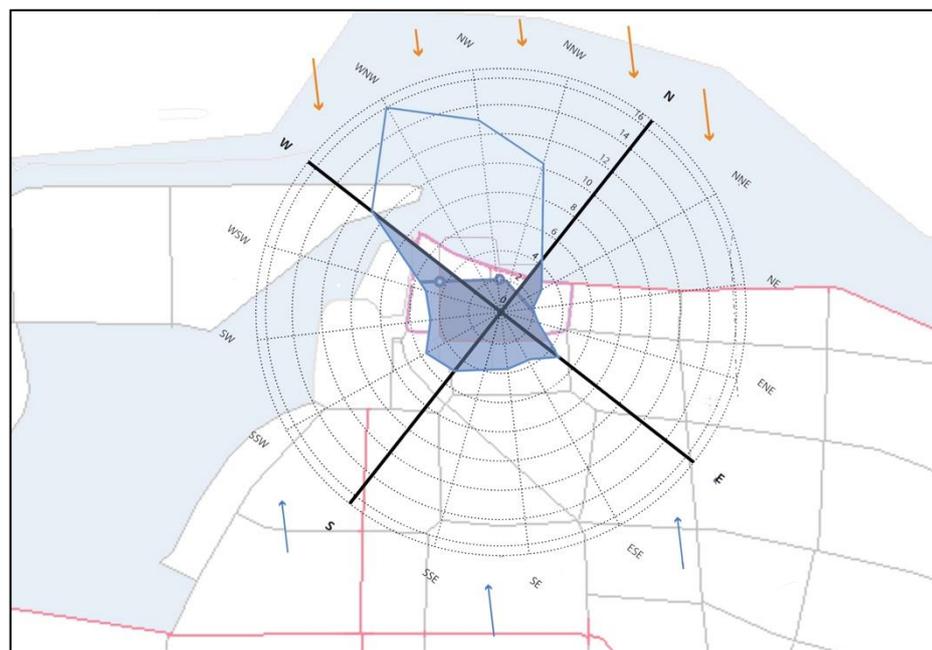


Figure 24: wind direction analysis.

There was a site visit to collect some climatic data and take some photos to the location and to observe people behaviour by noticing others attitude or by filling the survey. The visit was on 14th of June 2017. Extech 45179 device was used to measure the environmental data as shown in figure (25).



Figure 25: Extech 45179-4 in 1 environmental meter.

This device has four functions (temperature, humidity, and wind velocity and lux meter) that help in measuring data at once. It used to measure the temperature, humidity and wind speed for five different points in the location as shown in the figure (26).

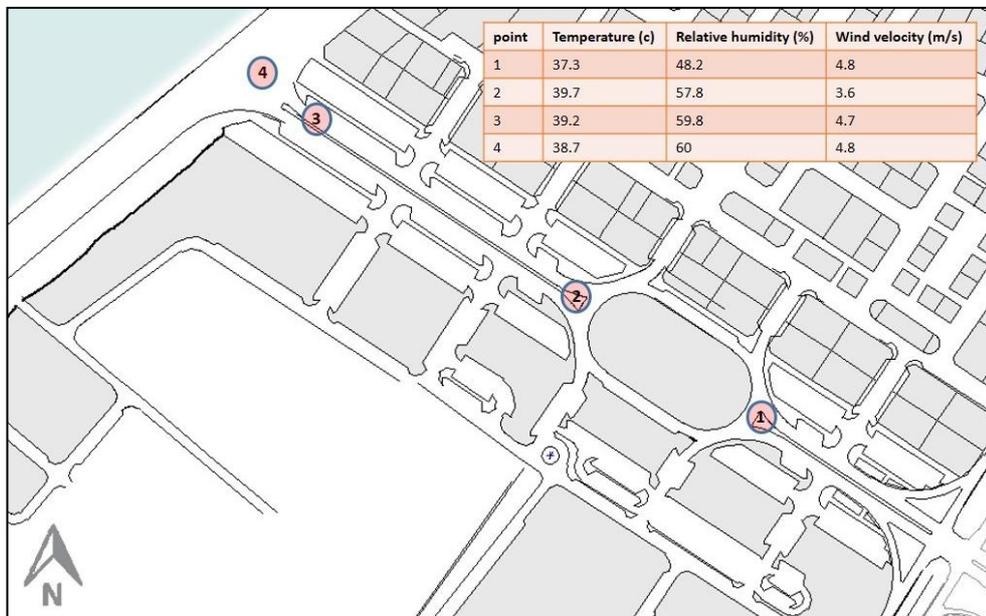


Figure 26: Measurement points at the location (author).

4.3. Survey analysis

Survey Validity

To achieve good quality and validate survey, it needs care in the survey design and sample selection. Also, it should serve the aims and the concept of the study. Therefore, the supervisor Prof. Bassam Abuhijleh and two experts to check the content of the survey and identify if the questions reflect the scope of the study amended the survey. Dr. Ghada Hafiz a doctor in urban planning and Mr. Mohammad Hafiz, master in urban planning, evaluated whether the questions met the scope of the study. The experts validated and agreed on the survey. For statistical validation, Pearson tests used and reliability test by using SPSS software. Structure validity used to check the validity of each section with the whole survey.

For significance validation (Cope, 2015):

- If p- value less than 0.05, then the relationship is significant.
- If p- value more than 0.05, then the relationship is not significant.

For reliability validation (Hof, 2012):

- If alpha, more than 0.70, then reliability is high.
- If alpha, between 0.50 and 0.70, then reliability is quite high.
- If alpha, less than 0.50, then reliability is low.

All validation schedules for correlation and reliability from SPSS are at appendix section.

Population and Sample Size

The study conduct in Sharjah city in UAE, in one district (Muraija) with a total population of 6351, the specific location called the heart of Sharjah. Sample size determined by using Glenn (1992) study. A 95% confidence level and margin error of .05 for $\pm 10\%$ precision levels are assumed to calculate the sample size. Respects to Aiay (2014) study, figure (27) presents the sample size with error percentage.

Size of Population	Sample Size (n) for Precision (e) of:			
	$\pm 3\%$	$\pm 5\%$	$\pm 7\%$	$\pm 10\%$
500	a	222	145	83
600	a	240	152	86
700	a	255	158	88
800	a	267	163	89
900	a	277	166	90
1,000	a	286	169	91
2,000	714	333	185	95
3,000	811	353	191	97
4,000	870	364	194	98
5,000	909	370	196	98
6,000	938	375	197	98
7,000	959	378	198	99
8,000	976	381	199	99
9,000	989	383	200	99
10,000	1,000	385	200	99
15,000	1,034	390	201	99
20,000	1,053	392	204	100
25,000	1,064	394	204	100
50,000	1,087	397	204	100
100,000	1,099	398	204	100
>100,000	1,111	400	204	100

a = Assumption of normal population is poor (Yamane, 1967). The entire population should be sampled.

Figure 27: sample size for the survey (Ajay, 2014).

98 questionnaires required as a sample size of this study. The questionnaires concentrated in the target location (the heart of Sharjah), 100% received.

4.4. Survey results and discussion

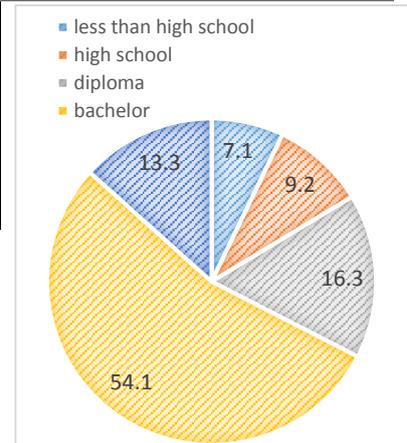
The collected data from the survey were sorted and coded by Excel software. Then analysed by SPSS software. With most appropriate graphical representation to gain intensive analytical understanding. The ordinal scale used with frequencies and percentile. Tables (8-11) represent the results of the survey.

Following is a summary of the survey's results:

Table 8: general information section output (SPSS).

<i>NO.</i>	<i>QUESTION</i>	<i>PERCENTAGE</i>	<i>FREQUENCY</i>	<i>CHART</i>
<i>1</i>	<i>gender</i>			
	male	63.3	62	
	female	36.7	36	
	total	100	98	
<i>2</i>	<i>age</i>			
	less than 18	6.1	6	
	19-26	11.2	11	
	27-45	57.1	56	
	46-65	23.5	23	
	more than 65	2	2	
	total	100	98	

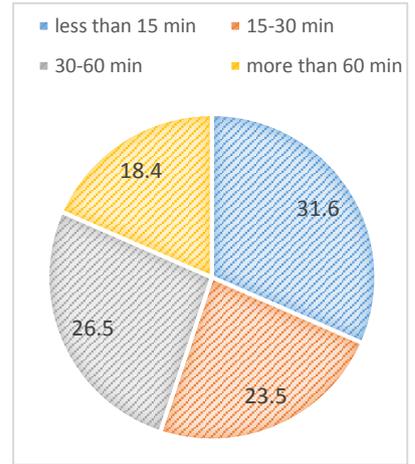
<i>3</i>	<i>education</i>		
	less than high school	7.1	7
	high school	9.2	9
	diploma	16.3	16
	bachelor	54.1	53
	post graduated	13.3	13
	total	100	98



<i>4</i>	<i>job</i>		
	employee	85.7	84
	student	8.2	8
	private business	1	1
	housewife	3.1	3
	without work	1	1
	others	1	1
	total	100	98

<i>5</i>	<i>workplace</i>		
	inside neighbourhood	41.8	41
	outside neighbourhood	32.7	32
	outside city	15.3	15
	others	10.2	10
	total	100	98

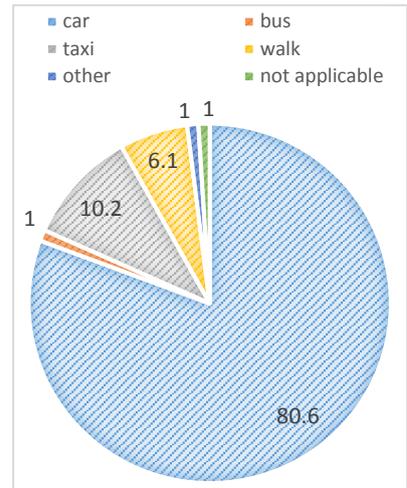
6	<i>time to arrive at the workplace</i>		
	less than 15 min	31.6	31
	15-30 min	23.5	23
	30-60 min	26.5	26
	more than 60 min	18.4	18
	total	100	98



7	<i>distance can walk on feet</i>		
	5 min	10.2	10
	10 min	14.3	14
	15 min	18.4	18
	more than 15 min	57.1	56
	total	100	98

8	<i>last shifting</i>		
	within the same street	17.3	17
	within the same neighborhood	28.6	28
	within the same emarite	35.7	35
	another emirate	18.4	18
	total	100	98

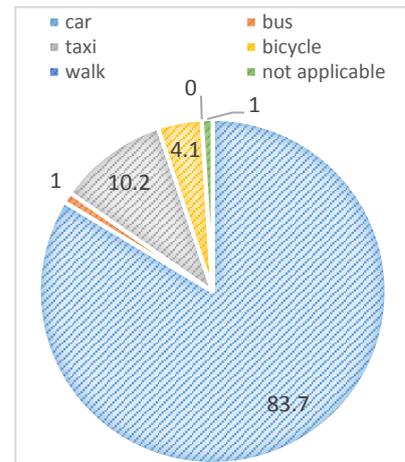
9.1	<i>more frequent transport mode</i>	<i>shopping</i>	
	car	80.6	79
	bus	1	1
	taxi	10.2	10
	walk	6.1	6
	other	1	1
	not applicable	1	1
	total	100	98



9.2	<i>more frequent transport mode</i>	<i>work</i>	
	car	68.4	67
	bus	8.2	8
	taxi	2	2
	walk	15.3	15
	other	1	1
	not applicable	5	5
	total	100	98

9.3	<i>more frequent transport mode</i>	<i>leisure</i>	
	car	73.5	72
	bus	2	2
	taxi	9	9
	bicycle	1	1
	walk	13.3	13
	not applicable	1	1
	total	100	98

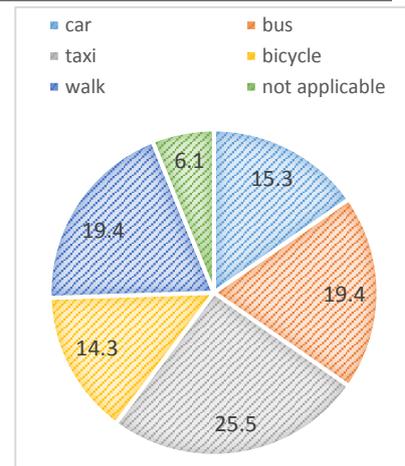
9.4	<i>more frequent transport mode</i>	<i>family visit</i>	
	car	83.7	82
	bus	1	1
	taxi	10.2	10
	bicycle	4.1	4
	walk	0	0
	not applicable	1	1
	total	100	98



9.5	<i>more frequent transport mode</i>	<i>school</i>	
	car	50	49
	bus	18.4	18
	taxi	2	2
	walk	1	1
	other	1	1
	not applicable	27.6	27
	total	100	98

9.6	<i>more frequent transport mode</i>	<i>local trip</i>	
	car	79.6	78
	bus	5.1	5
	taxi	8.2	8
	bicycle	2	2
	walk	0	0
	not applicable	5.1	5
	total	100	98

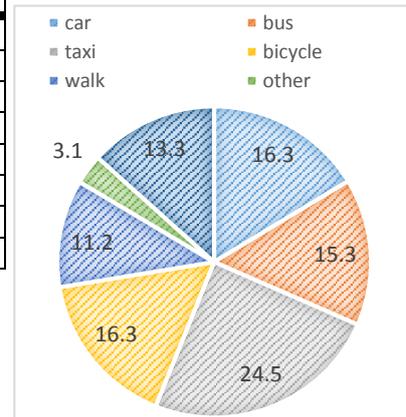
10.1	<i>less frequent transport mode</i>	<i>shopping</i>	
	car	15.3	15
	bus	19.4	19
	taxi	25.5	25
	bicycle	14.3	14
	walk	19.4	19
	not applicable	6.1	6
	total	100	98



10.2	<i>less frequent transport mode</i>	<i>work</i>	
	car	12.2	12
	bus	20.4	20
	taxi	21.4	21
	bicycle	17.3	17
	walk	15.3	15
	other	3.1	3
	not applicable	10.2	10
	total	100	98

10.3	<i>less frequent transport mode</i>	<i>leisure</i>	
	car	13.3	13
	bus	18.4	18
	taxi	18.4	18
	bicycle	17.3	17
	walk	19.4	19
	other	2	2
	not applicable	11.2	11
	total	100	98

10.4	<i>less frequent transport mode</i>	<i>family visit</i>	
	car	16.3	16
	bus	15.3	15
	taxi	24.5	24
	bicycle	16.3	16
	walk	11.2	11
	other	3.1	3
	not applicable	13.3	13
	total	100	98



10.5	<i>less frequent transport mode</i>	<i>school</i>	
	car	8.2	8
	bus	20.6	20
	taxi	18.6	18
	bicycle	11.3	11
	walk	9.3	9
	not applicable	32	32
	total	100	98

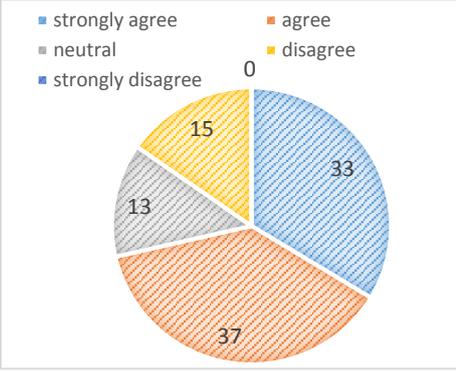
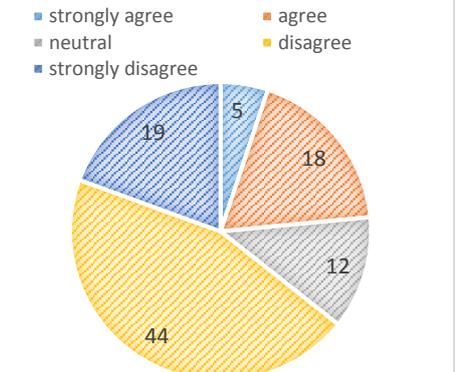
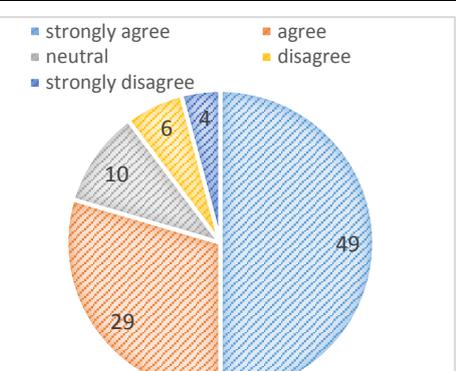
10.6	<i>less frequent transport mode</i>	<i>another trip</i>	
	car	13.3	13
	bus	17.3	17
	taxi	23.5	23
	bicycle	16.3	16
	walk	11.2	11
	other	1	1
	not applicable	17.3	17
	total	100	98

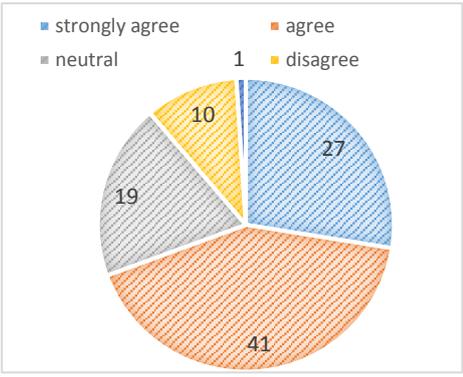
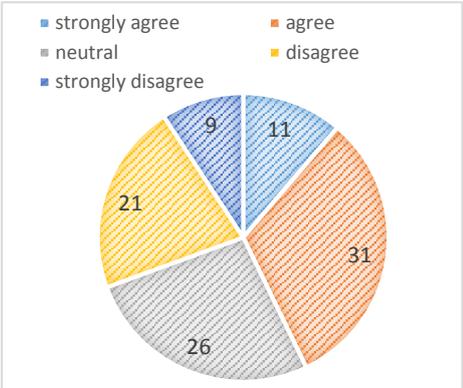
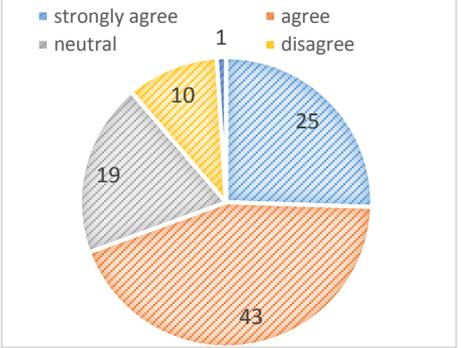
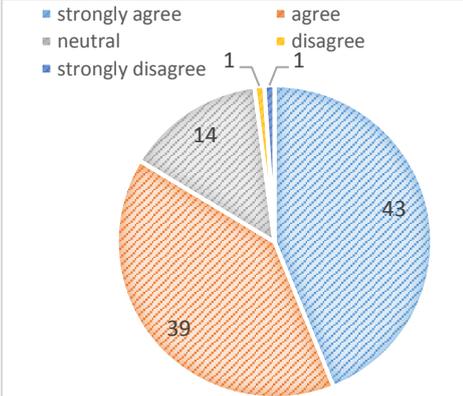
Main outcomes:

- A 41.8% of the sample preferred to live at the same place of their work.
- A 28.6% preferred to stay in the same neighborhood when they decide to change their home.
- A 57.1% of the sample results show agreed with the importance of walking.

- The survey shows a high dependence on using cars on different kind of trips. In most cases, car usage exceeds 50% of the various journeys.

Table 9: environmental awareness section output (SPSS).

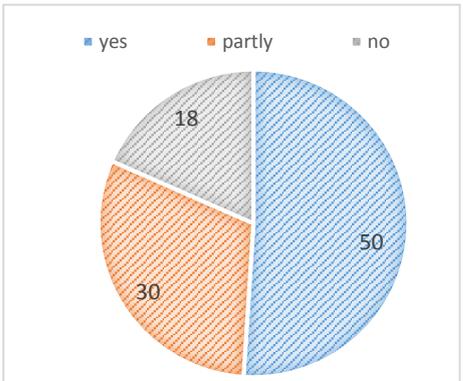
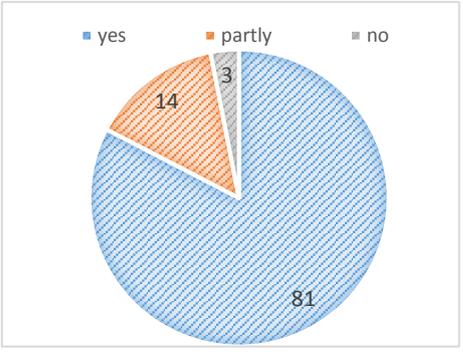
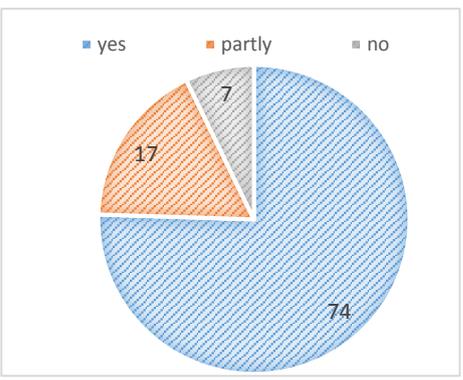
NO.	Question	Frequency				
		strongly agree	agree	neutral	disagree	strongly disagree
11.1	using public transport will help to tackle a problem like a climate change	33	37	13	15	0
		 <p>A pie chart representing the distribution of responses for question 11.1. The chart is divided into five segments: 'strongly agree' (blue, 33), 'agree' (orange, 37), 'neutral' (grey, 13), 'disagree' (yellow, 15), and 'strongly disagree' (dark blue, 0). A legend to the left of the chart identifies each response category with its corresponding color.</p>				
11.2	cars do not have very negative impact on the environment	5	18	12	44	19
		 <p>A pie chart representing the distribution of responses for question 11.2. The chart is divided into five segments: 'strongly agree' (blue, 19), 'agree' (orange, 18), 'neutral' (grey, 12), 'disagree' (yellow, 44), and 'strongly disagree' (dark blue, 5). A legend to the left of the chart identifies each response category with its corresponding color.</p>				
11.3	walking /cycling reduces negative environmental impact	49	29	10	6	4
		 <p>A pie chart representing the distribution of responses for question 11.3. The chart is divided into five segments: 'strongly agree' (blue, 49), 'agree' (orange, 29), 'neutral' (grey, 10), 'disagree' (yellow, 6), and 'strongly disagree' (dark blue, 4). A legend to the left of the chart identifies each response category with its corresponding color.</p>				

11.4	I consider fuel efficiency when I choose my car	27	41	19	10	1
		 <p> ■ strongly agree ■ agree ■ neutral ■ disagree </p>				
11.5	I use telephone and the internet to avoid traveling	11	31	26	21	9
		 <p> ■ strongly agree ■ agree ■ neutral ■ disagree ■ strongly disagree </p>				
11.6	I prefer buying things from closet store to avoid traveling	25	43	19	10	1
		 <p> ■ strongly agree ■ agree ■ neutral ■ disagree </p>				
11.7	in the ideal world, I will use environment-friendly choices of traveling	43	39	14	1	1
		 <p> ■ strongly agree ■ agree ■ neutral ■ disagree ■ strongly disagree </p>				

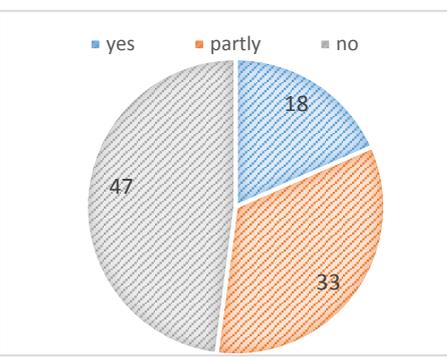
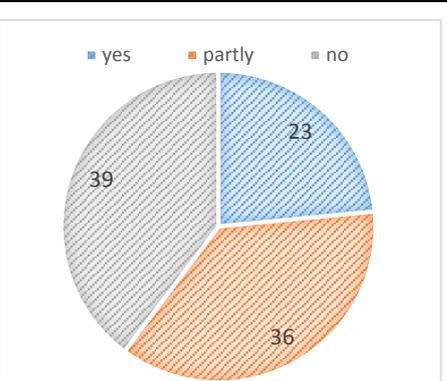
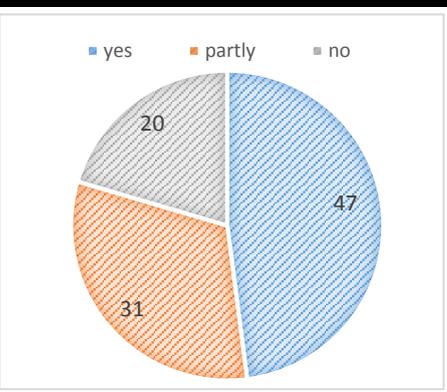
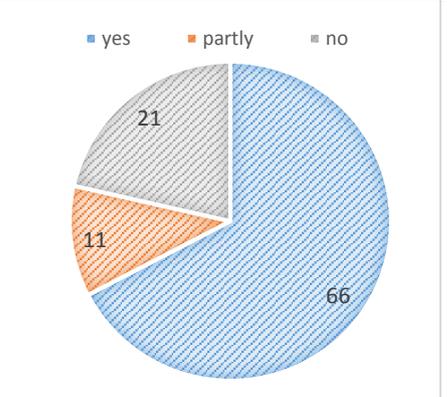
Main outcomes:

- The results show a high level of awareness of environmental issues; it appears in the percentage of environmental choice travel, which exceeds 80%.

Table 10: transportation and urban form section output (SPSS).

NO.	Question	Frequency		
		yes	partly	no
12.1	do you agree with the idea of existing all services in your area	50	30	18
		 <p>A pie chart illustrating the distribution of responses for question 12.1. The chart is divided into three segments: a large blue segment representing 'yes' at 50%, an orange segment representing 'partly' at 30%, and a grey segment representing 'no' at 18%. A legend above the chart identifies the colors: blue for 'yes', orange for 'partly', and grey for 'no'.</p>		
12.2	good transportation network may increase the quality of living	81	14	3
		 <p>A pie chart illustrating the distribution of responses for question 12.2. The chart is dominated by a blue segment representing 'yes' at 81%, with a smaller orange segment for 'partly' at 14% and a very small grey segment for 'no' at 3%. A legend above the chart identifies the colors: blue for 'yes', orange for 'partly', and grey for 'no'.</p>		
12.3	direct connection to the city center and highway may efficient transport.	74	17	7
		 <p>A pie chart illustrating the distribution of responses for question 12.3. The chart shows a blue segment for 'yes' at 74%, an orange segment for 'partly' at 17%, and a grey segment for 'no' at 7%. A legend above the chart identifies the colors: blue for 'yes', orange for 'partly', and grey for 'no'.</p>		

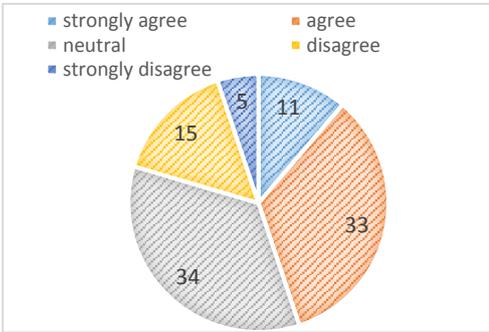
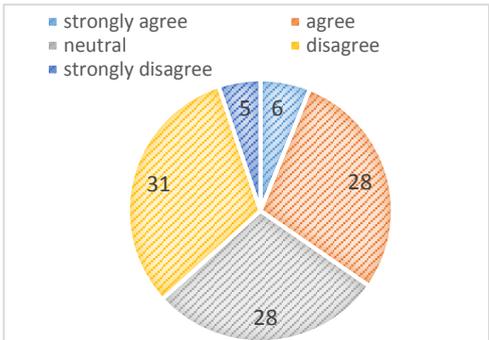
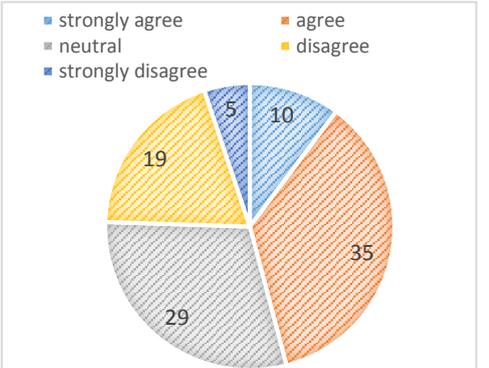
12.4	do you think that your area has easy access to community services	58	26	14
		<p>A pie chart illustrating the distribution of responses for question 12.4. The chart is divided into three segments: a large blue segment representing 'yes' at 58%, an orange segment representing 'partly' at 26%, and a grey segment representing 'no' at 14%. A legend above the chart identifies the colors: blue for 'yes', orange for 'partly', and grey for 'no'.</p>		
12.5	do you find it easy to access to public transportation	25	31	42
		<p>A pie chart illustrating the distribution of responses for question 12.5. The chart is divided into three segments: a blue segment representing 'yes' at 25%, an orange segment representing 'partly' at 31%, and a grey segment representing 'no' at 42%. A legend above the chart identifies the colors: blue for 'yes', orange for 'partly', and grey for 'no'.</p>		
12.6	do you find your area encourage you to walk/cycling	43	26	29
		<p>A pie chart illustrating the distribution of responses for question 12.6. The chart is divided into three segments: a blue segment representing 'yes' at 43%, an orange segment representing 'partly' at 26%, and a grey segment representing 'no' at 29%. A legend above the chart identifies the colors: blue for 'yes', orange for 'partly', and grey for 'no'.</p>		
12.7	do you find your area is safe to your children on roads	23	31	44
		<p>A pie chart illustrating the distribution of responses for question 12.7. The chart is divided into three segments: a blue segment representing 'yes' at 23%, an orange segment representing 'partly' at 31%, and a grey segment representing 'no' at 44%. A legend above the chart identifies the colors: blue for 'yes', orange for 'partly', and grey for 'no'.</p>		

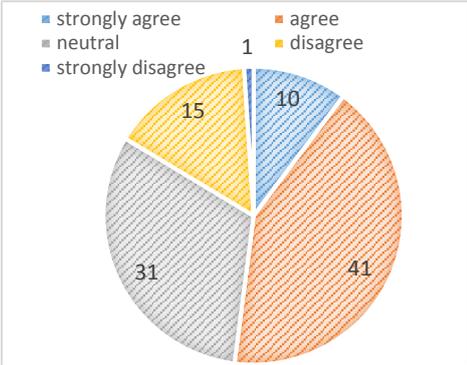
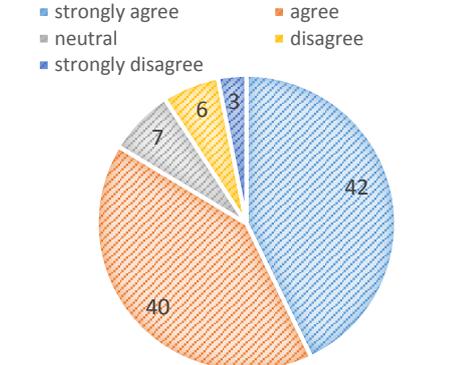
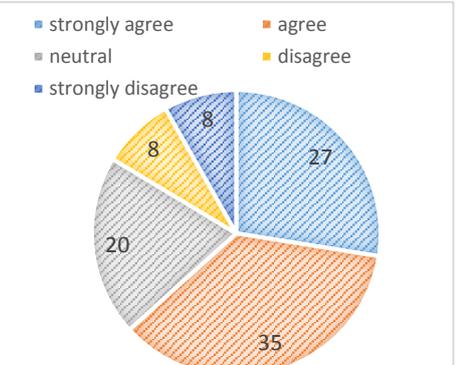
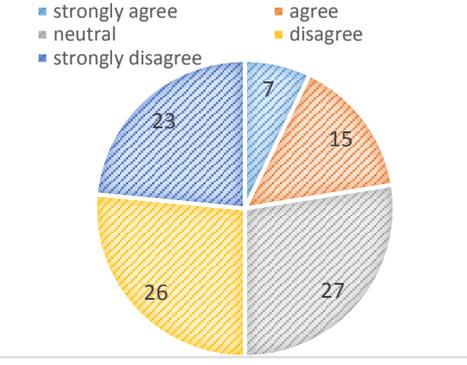
12.8	do you find the streets in your area has a good furniture	18	33	47
		 <p>A pie chart illustrating the distribution of responses for question 12.8. The chart is divided into three segments: 'yes' (blue, 18%), 'partly' (orange, 33%), and 'no' (grey, 47%). A legend at the top identifies the colors: blue for 'yes', orange for 'partly', and grey for 'no'.</p>		
12.9	streets have a good structure to encourage you walking/cycling	23	36	39
		 <p>A pie chart illustrating the distribution of responses for question 12.9. The chart is divided into three segments: 'yes' (blue, 23%), 'partly' (orange, 36%), and 'no' (grey, 39%). A legend at the top identifies the colors: blue for 'yes', orange for 'partly', and grey for 'no'.</p>		
12.1	do you like to spend time outdoors in your area	47	31	20
		 <p>A pie chart illustrating the distribution of responses for question 12.1. The chart is divided into three segments: 'yes' (blue, 47%), 'partly' (orange, 31%), and 'no' (grey, 20%). A legend at the top identifies the colors: blue for 'yes', orange for 'partly', and grey for 'no'.</p>		
12.11	do you find any difficulty in parking your car in your area	66	11	21
		 <p>A pie chart illustrating the distribution of responses for question 12.11. The chart is divided into three segments: 'yes' (blue, 66%), 'partly' (orange, 11%), and 'no' (grey, 21%). A legend at the top identifies the colors: blue for 'yes', orange for 'partly', and grey for 'no'.</p>		

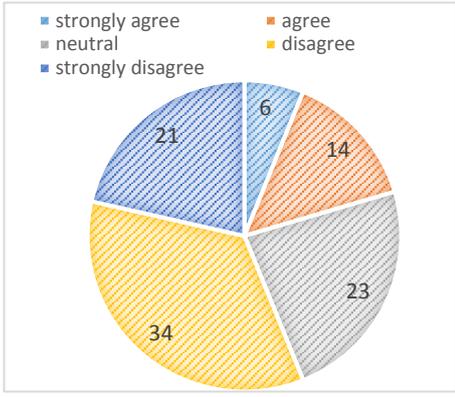
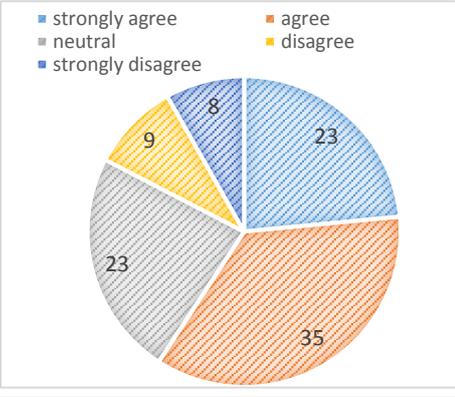
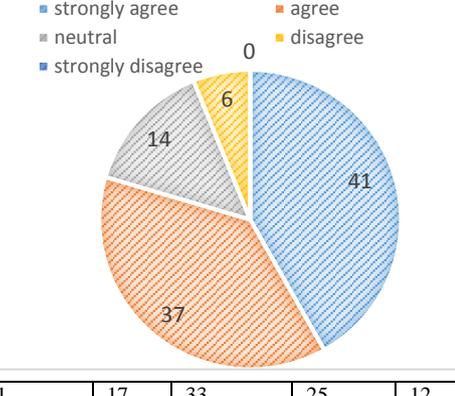
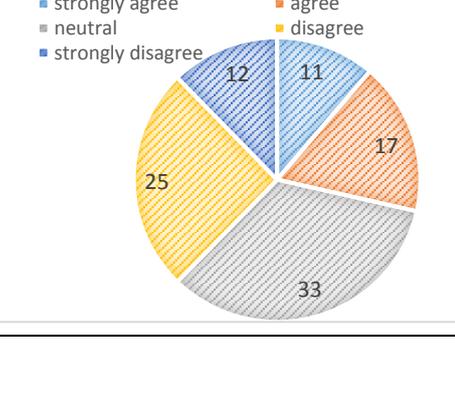
Main outcomes:

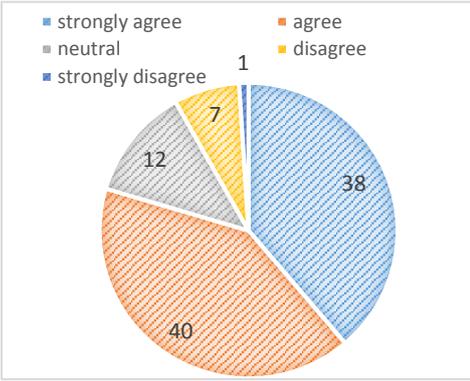
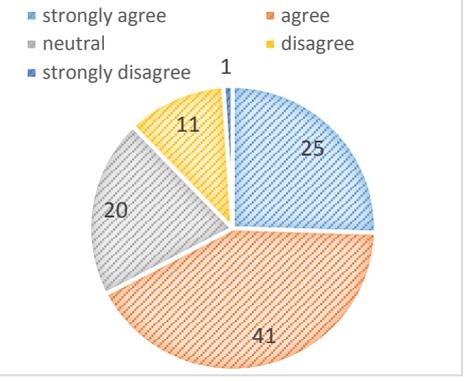
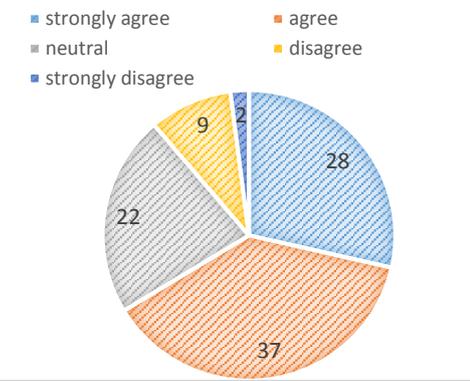
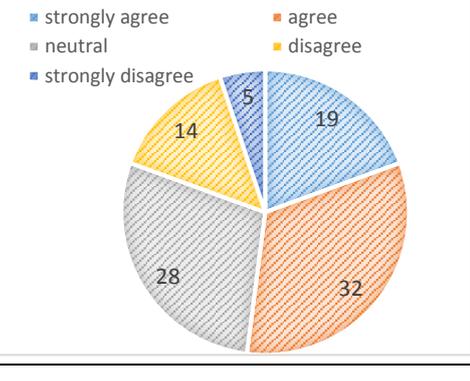
- The results in this section show a great relationship between urban form and transportation mode. More than 80% of the respondents agree with the effect of good transportation network at the quality of life. 39% of the responds shows discourage of road structure on the walking and cycling in their area.

Table 11: travel attitude section output (SPSS).

NO.	Question	Frequency				
		strongly agree	agree	neutral	disagree	strongly disagree
13.1	using public transport is convenient	11	33	34	15	5
						
13.2	there is a good level of information about public transport	6	28	28	31	5
						
13.3	public transport is affordable and good value	10	35	29	19	5
						

13.4	using public transport is the safest travel choice	10	41	31	15	1												
		 <table border="1" data-bbox="911 286 1378 651"> <thead> <tr> <th>Response</th> <th>Percentage</th> </tr> </thead> <tbody> <tr> <td>strongly agree</td> <td>10</td> </tr> <tr> <td>agree</td> <td>41</td> </tr> <tr> <td>neutral</td> <td>31</td> </tr> <tr> <td>disagree</td> <td>15</td> </tr> <tr> <td>strongly disagree</td> <td>1</td> </tr> </tbody> </table>					Response	Percentage	strongly agree	10	agree	41	neutral	31	disagree	15	strongly disagree	1
Response	Percentage																	
strongly agree	10																	
agree	41																	
neutral	31																	
disagree	15																	
strongly disagree	1																	
13.5	using the car is the simplest way to travel	42	40	7	6	3												
		 <table border="1" data-bbox="911 712 1378 1077"> <thead> <tr> <th>Response</th> <th>Percentage</th> </tr> </thead> <tbody> <tr> <td>strongly agree</td> <td>42</td> </tr> <tr> <td>agree</td> <td>40</td> </tr> <tr> <td>neutral</td> <td>7</td> </tr> <tr> <td>disagree</td> <td>6</td> </tr> <tr> <td>strongly disagree</td> <td>3</td> </tr> </tbody> </table>					Response	Percentage	strongly agree	42	agree	40	neutral	7	disagree	6	strongly disagree	3
Response	Percentage																	
strongly agree	42																	
agree	40																	
neutral	7																	
disagree	6																	
strongly disagree	3																	
13.6	reducing car use is not an individual's responsibility	27	35	20	8	8												
		 <table border="1" data-bbox="911 1160 1378 1525"> <thead> <tr> <th>Response</th> <th>Percentage</th> </tr> </thead> <tbody> <tr> <td>strongly agree</td> <td>27</td> </tr> <tr> <td>agree</td> <td>35</td> </tr> <tr> <td>neutral</td> <td>20</td> </tr> <tr> <td>disagree</td> <td>8</td> </tr> <tr> <td>strongly disagree</td> <td>8</td> </tr> </tbody> </table>					Response	Percentage	strongly agree	27	agree	35	neutral	20	disagree	8	strongly disagree	8
Response	Percentage																	
strongly agree	27																	
agree	35																	
neutral	20																	
disagree	8																	
strongly disagree	8																	
13.7	increasing fuel taxes to discourage car use	7	15	27	26	23												
		 <table border="1" data-bbox="911 1630 1378 1995"> <thead> <tr> <th>Response</th> <th>Percentage</th> </tr> </thead> <tbody> <tr> <td>strongly agree</td> <td>7</td> </tr> <tr> <td>agree</td> <td>15</td> </tr> <tr> <td>neutral</td> <td>27</td> </tr> <tr> <td>disagree</td> <td>26</td> </tr> <tr> <td>strongly disagree</td> <td>23</td> </tr> </tbody> </table>					Response	Percentage	strongly agree	7	agree	15	neutral	27	disagree	26	strongly disagree	23
Response	Percentage																	
strongly agree	7																	
agree	15																	
neutral	27																	
disagree	26																	
strongly disagree	23																	

13.8	increasing parking charges to discourage car use	6	14	23	34	21
		 <p> ■ strongly agree ■ agree ■ neutral ■ disagree ■ strongly disagree </p>				
13.9	giving buses priority on the street	23	35	23	9	8
		 <p> ■ strongly agree ■ agree ■ neutral ■ disagree ■ strongly disagree </p>				
13.1	short distance trip is preferable to walk	41	37	14	6	0
		 <p> ■ strongly agree ■ agree ■ neutral ■ disagree ■ strongly disagree </p>				
13.11	the performance of the current transportation network and public transport is excellent	11	17	33	25	12
		 <p> ■ strongly agree ■ agree ■ neutral ■ disagree ■ strongly disagree </p>				

13.12	is the idea of afforesting lighting and furnishing streets encourage you to walk	38	40	12	7	1												
		 <table border="1" data-bbox="900 293 1370 674"> <thead> <tr> <th>Response</th> <th>Percentage</th> </tr> </thead> <tbody> <tr> <td>strongly agree</td> <td>38</td> </tr> <tr> <td>agree</td> <td>40</td> </tr> <tr> <td>neutral</td> <td>12</td> </tr> <tr> <td>disagree</td> <td>7</td> </tr> <tr> <td>strongly disagree</td> <td>1</td> </tr> </tbody> </table>					Response	Percentage	strongly agree	38	agree	40	neutral	12	disagree	7	strongly disagree	1
Response	Percentage																	
strongly agree	38																	
agree	40																	
neutral	12																	
disagree	7																	
strongly disagree	1																	
13.13	do you think that depending on public transport can contribute to solving the fuel problem	25	41	20	11	1												
		 <table border="1" data-bbox="900 745 1370 1126"> <thead> <tr> <th>Response</th> <th>Percentage</th> </tr> </thead> <tbody> <tr> <td>strongly agree</td> <td>25</td> </tr> <tr> <td>agree</td> <td>41</td> </tr> <tr> <td>neutral</td> <td>20</td> </tr> <tr> <td>disagree</td> <td>11</td> </tr> <tr> <td>strongly disagree</td> <td>1</td> </tr> </tbody> </table>					Response	Percentage	strongly agree	25	agree	41	neutral	20	disagree	11	strongly disagree	1
Response	Percentage																	
strongly agree	25																	
agree	41																	
neutral	20																	
disagree	11																	
strongly disagree	1																	
13.14	Do you think the idea of encouraging the walk and using public transport? Can improve social life	28	37	22	9	2												
		 <table border="1" data-bbox="900 1202 1370 1583"> <thead> <tr> <th>Response</th> <th>Percentage</th> </tr> </thead> <tbody> <tr> <td>strongly agree</td> <td>28</td> </tr> <tr> <td>agree</td> <td>37</td> </tr> <tr> <td>neutral</td> <td>22</td> </tr> <tr> <td>disagree</td> <td>9</td> </tr> <tr> <td>strongly disagree</td> <td>2</td> </tr> </tbody> </table>					Response	Percentage	strongly agree	28	agree	37	neutral	22	disagree	9	strongly disagree	2
Response	Percentage																	
strongly agree	28																	
agree	37																	
neutral	22																	
disagree	9																	
strongly disagree	2																	
13.15	do you think that public transport is satisfying with disabled people	19	32	28	14	5												
		 <table border="1" data-bbox="900 1673 1370 2054"> <thead> <tr> <th>Response</th> <th>Percentage</th> </tr> </thead> <tbody> <tr> <td>strongly agree</td> <td>19</td> </tr> <tr> <td>agree</td> <td>32</td> </tr> <tr> <td>neutral</td> <td>28</td> </tr> <tr> <td>disagree</td> <td>14</td> </tr> <tr> <td>strongly disagree</td> <td>5</td> </tr> </tbody> </table>					Response	Percentage	strongly agree	19	agree	32	neutral	28	disagree	14	strongly disagree	5
Response	Percentage																	
strongly agree	19																	
agree	32																	
neutral	28																	
disagree	14																	
strongly disagree	5																	

Main outcomes:

- This section shows a confused responded when the survey asked about their attitude toward using or data about transport modes. That appears on the high percentage of neutral response in the questions. 34% does not know if public transportation is convenient or not. 28% does not know if the public transportation is satisfying with disabled people.

Survey discussion

Analysis of the survey based on SPSS shows that the most of the participants are employees (85.7%) which are in line with the Sharjah' 2015 census (figure 13) that show the high percentage of the employee in the emirate. Most of these employees try to stay in the same area they work in with 31.6% of respondent taking less than 15 min to reach their workplace and 41.8% work in the neighbourhood; this indicates that people try to avoid long trips and to be close to their jobs. Which parallel with Nass (2012) study of *distance decay*, that means most of the people tend to orient themselves in a smaller range and more local areas even the opportunities and facilities are limited. Also, this help planner to decide the best urban design of the walkable neighbourhood. If the high percentage of the respondents could walk for 15 min (1 km) that guide planner to make their neighbourhood size within these average. Moreover, when people asked about home shifting distance, most of them (with a percentage of 28.6%) prefer to be in the same neighborhood, and 17.3% move within the same street. That means they stay to use the same travel mode and make their travel behaviour unchangeable. This line with Handy *et al.* (2005) study that people attitude changed with time and circumstances. Such as when people move from one form of living to another. The analysis shows a high tendency of walkability. A 57.1% of the respondent shows a strong tendency of walking to their work. This attitude is caused by many reasons such as saving time, money or for health conditions. However, this indicates the high demand for new policies to improve the public transportation and walkable streets to enhance this attitude.

The results mark a high usage of a car by comparing the regular transport mode at most frequent and less used one. As shown in figure (28) most of the respondent's trips depend on the car with a slight percentage especially for a family visit and

shopping trips with 83.7-80.6% in the order. Even with the less frequent mode, it still has the highest rate than other. That match with the literature review of (Engebretsen, Hanssen & Strand 2010) study which found a high level of car use to the shopping malls in his study of Nordic cities. That makes sense, as people need to carry many things from shopping or need to expend a long time with their family, so they prefer to get a convenient and comfort transit to their home. Unless the public transportation was prepared in a convenient way that provides continuity, affordability and convenient for a different type of traveling trips. Metro Dubai, for example, has a limited time until 12:00 am in the weekday and 1:00 am on the weekend day that reduces the opportunities to use it for a late time.

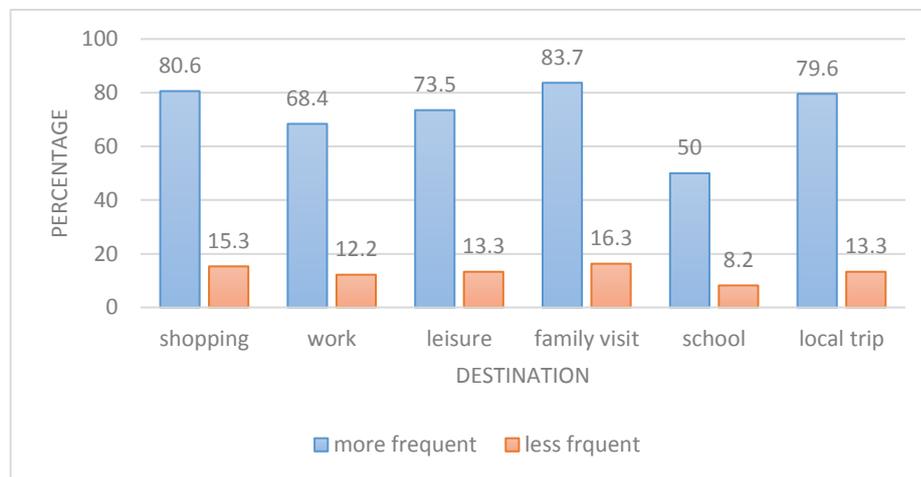


Figure 28: Car usage comparative of most and less frequent use (SPSS).

On the other hand, the results of walkability, figure (29) show a variation between the high and less frequent. However, the high percentage of preferring walkability in case of providing an excellent condition that encourages walkability in the area need to concern and put good policies to enhance this attitude of residents. For example, considering walkable distance to different services such as shopping centre, educational or leisure destinations or give more attention to street design and walkable path at the local scale. This match with Westford (2010) study for children travel attitude to their school, and he found that the street pattern and design play a fundamental role in children attitude as mentioned in the literature review section.

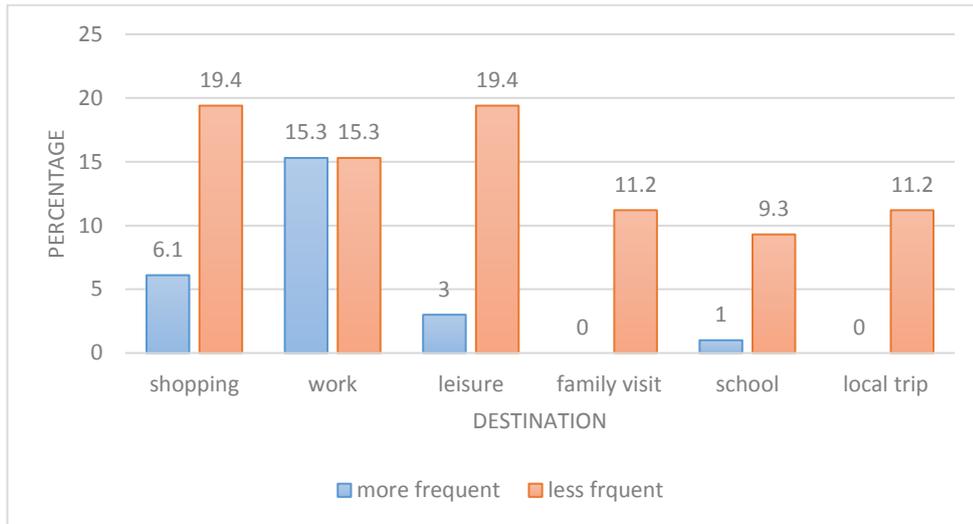


Figure 29: Walkability comparative of most and less frequent use (SPSS).

For public transportation, the usage of the bus shows a high variation in a different destination as present in figure (30). However, school trips have a small change that is 2.2%. This because schools are providing buses to collect their students. Therefore, most of the children already used school buses. However, this attitude whether using public transportation or school buses, the high percentage can influence the sustainable development differently by decreasing the congestion or traffic difficulties of reducing the environmental impact.

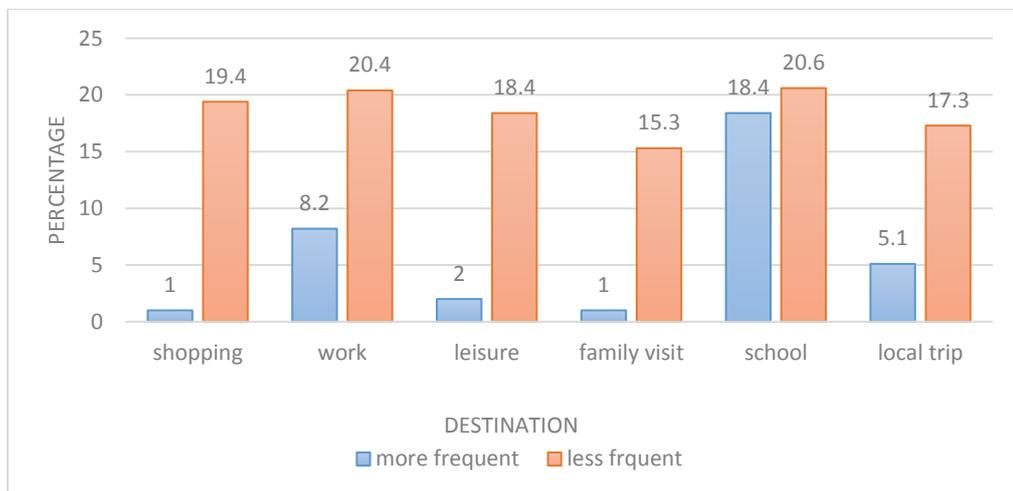


Figure 30: Bus usage comparative of most and less frequent use (SPSS).

For taxi usage, the graph shows high variation in some destination, such as school trips and work trips. Nevertheless, the most interesting note is the high usage of a taxi as the second choice of traveling mode. Figure (31) demonstrate the percentage of taxi usage.

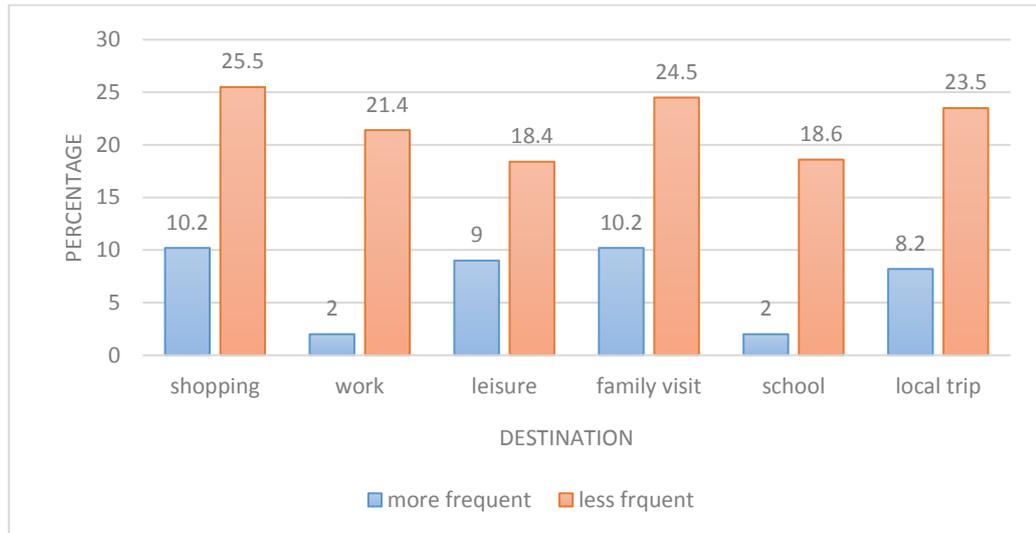


Figure 31: Taxi usage comparative of most and less frequent use (SPSS).

Overall, the results show a high dependency on a car as a first choice, and taxi usage as a second option. These results are reflected in the integration map (figure 4.22) in the previous chapter that indicates the most reachable street that can predict the pedestrian movement. Most of the streets show less integration mainly inner streets of the neighbourhood. These results need a top concern of urban planning to maximize the opportunity of using public transportation and walkability. For environmental awareness, the results show a high environmental awareness in choosing a traveling mode. 78% of the respondents strongly agree with walking and cycling for the positive impact to the environment. 63% of the respondents agree with the adverse implications of the car to the environment. Figure (32) shows this percentage.

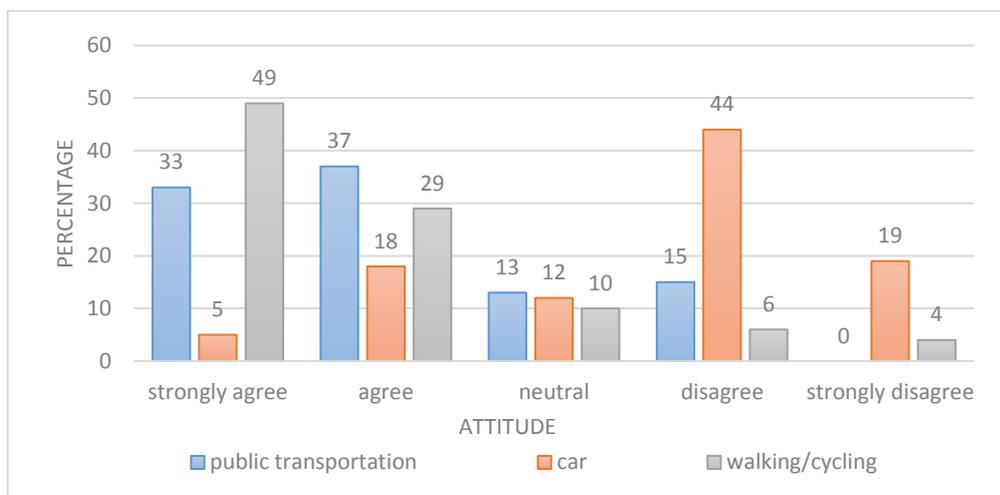


Figure 32: measuring environmental awareness of traveling mode (SPSS).

From another perspective, life style of the people can affect the environment, Figure (33) respondents show a strong agree with environmentally friendly travel choices. For choosing a fuel efficiency car, 68% of respondents agree with selecting a fuel efficiency car when they buy a car. The percentage of interviewees for other methods like using a telephone or the internet to buy things are not varied which reflect the different attitude toward technology role in reducing the adverse environmental impact.

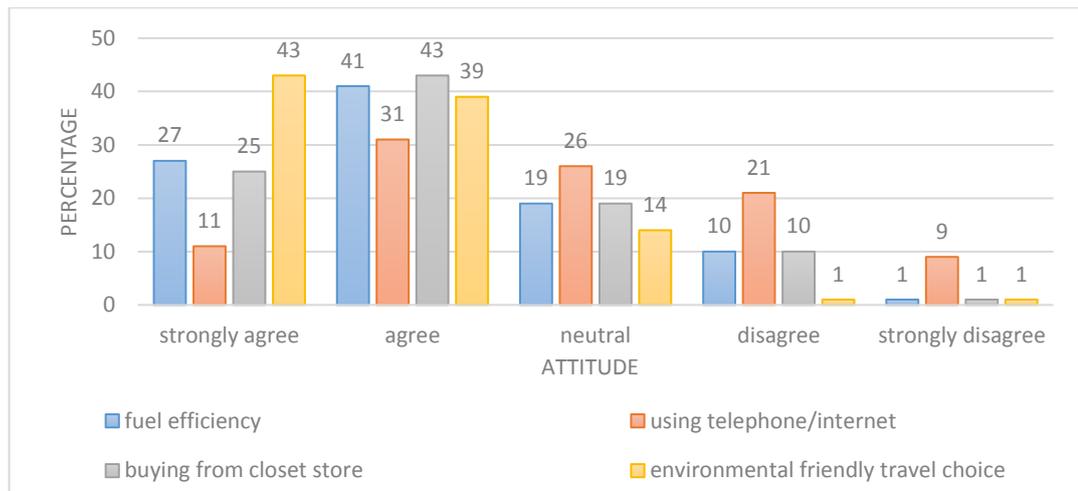


Figure 33: measuring environmental awareness of life style (SPSS).

The accessibility of different facilities can gauge the comfort of residents to reach their destination. By using a scale of yes, partly and no, to measure the satisfaction of the selected neighbourhood residents of their ability of accessibility to different facilities. Figure (34) shows that 74% of the people are satisfied with their community connection to the city centre. Moreover, 58% of respondents are pleased with their services accessibility. Meanwhile, 42% of the answer were not satisfied with their public transportation services. Walking and cycling encouragement has a 43% of respondents satisfying. Leonard Cheshire, 2007 points to the importance of accessibility to encourage people to use public transit. That match with the results of individuals attitudes toward accessibility of their community services or to the city centre. However, the dissatisfaction of the public transportation accessibility makes them discouraged to change their traveling mode. This ability of road network to access to the different destination should motivate stakeholder to implement a new travel plan that meets people demand and behaviour.

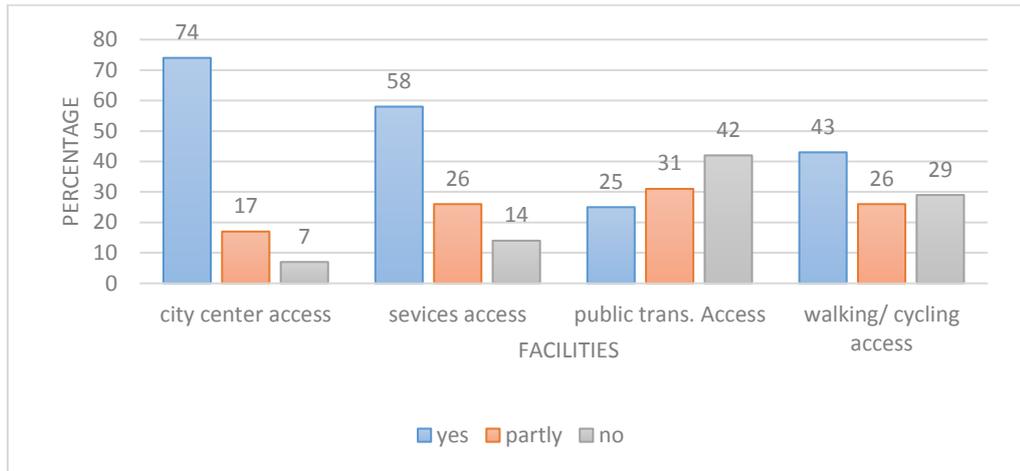


Figure 34: measuring accessibility for various facilities (SPSS).

The Urban form has different elements that can affect the way of movement. Services such as education, health, and commercial and so on, should be at a reachable distance. 50% of respondents find their neighbourhood has good access to different services. 81% of answers locate the transport network has good access. As shown in figure (35) other urban elements need more improvement as street furniture and the availability of car parking as 66% find there is not enough car parking in the area. For road safety, 44% believe that their way needs to be safer to their children.



Figure 35: measuring an urban form of different elements (SPSS).

Studying public transportation performance could help in improving the whole system to gain a sustainable transportation. From figure (36) respondents show the uncertainty of public transit performance. Agree, neutral and disagree response are close to each other. This hesitation because of the little use of public transportation and the great independence on private vehicles. Therefore, respondents do not have enough experience in public transit.

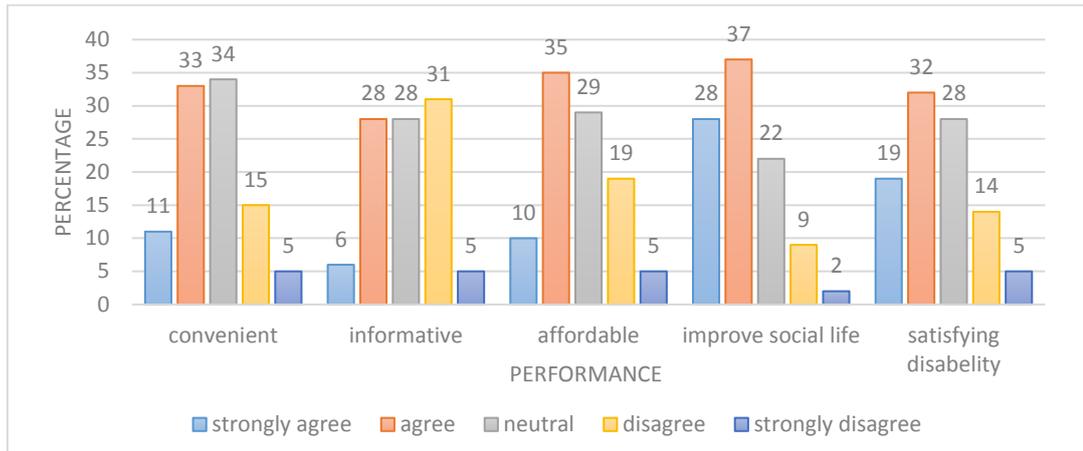


Figure 36: public transit performance (SPSS).

For the ways of reducing car use, figure (37) shows three primary methods were used to measure people attitude. 62% of answers agree that reducing vehicle use is not an individual responsibility. For increasing fuel taxes, the respondents show a tendency of discouraging of this method, 49% disagree with this procedure. The same attitude for increasing car-parking charge that has 55% of respondents does not agree with this approach. That indicates the importance of finding new strategies to reduce car dependency beyond charges and taxes. That encourage urban planners and developers to find new approaches to their urban design like high densities, closet facilities and prepare safe streets. Besides, applying new travel plan or new technology of traveling mode that support environmental aspects.

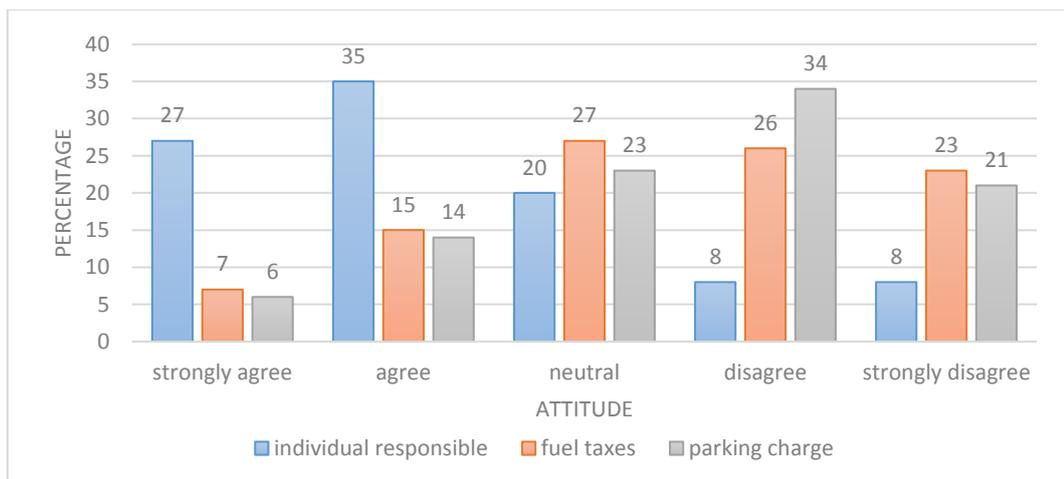


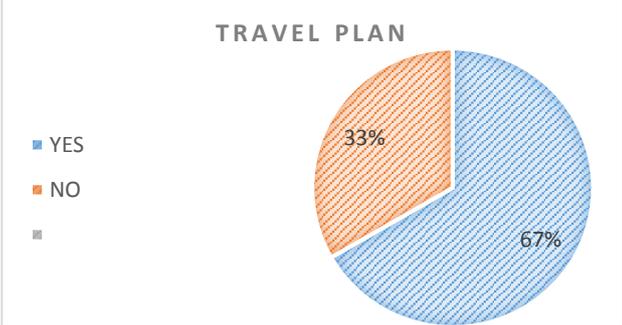
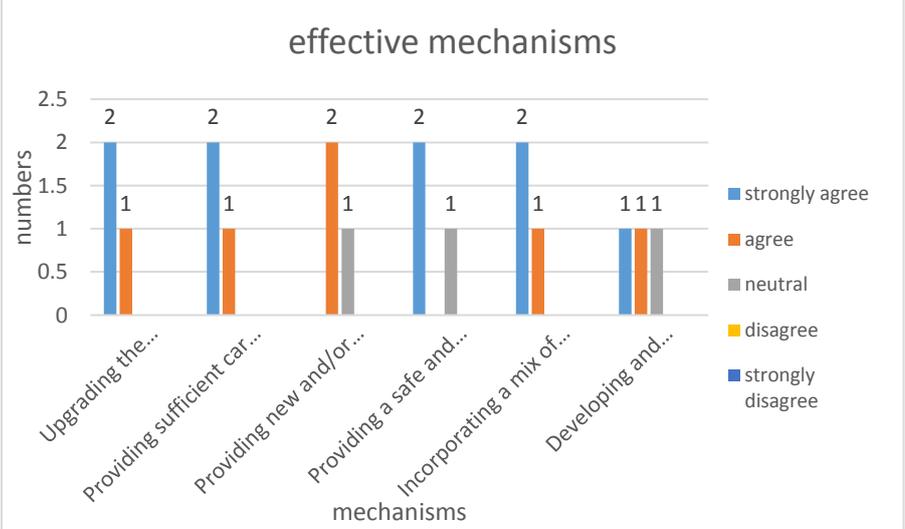
Figure 37: reducing car usage method (SPSS).

4.5.semi-structured interview results and analysis

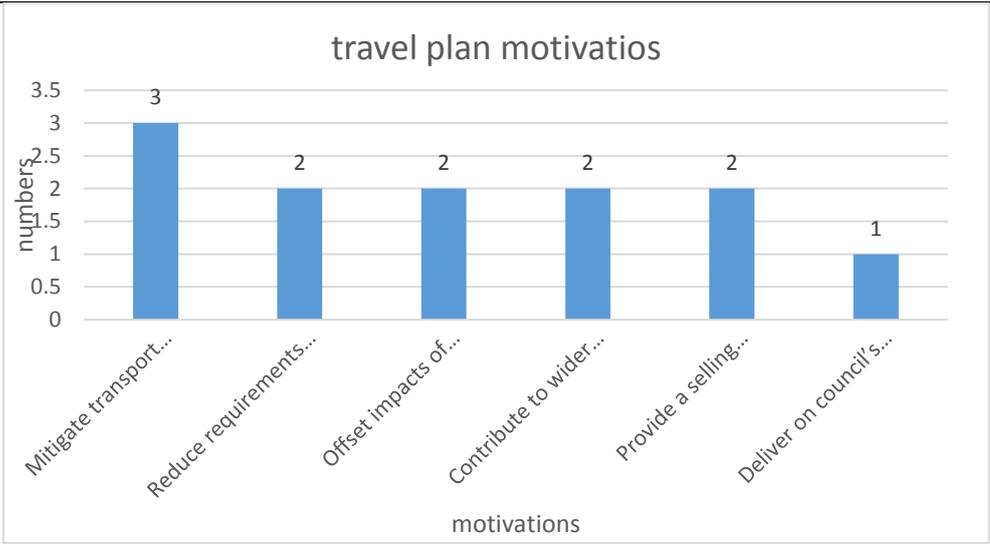
Results

Some of the results are qualitative, and others are quantitative. All answers are summarized as follows:

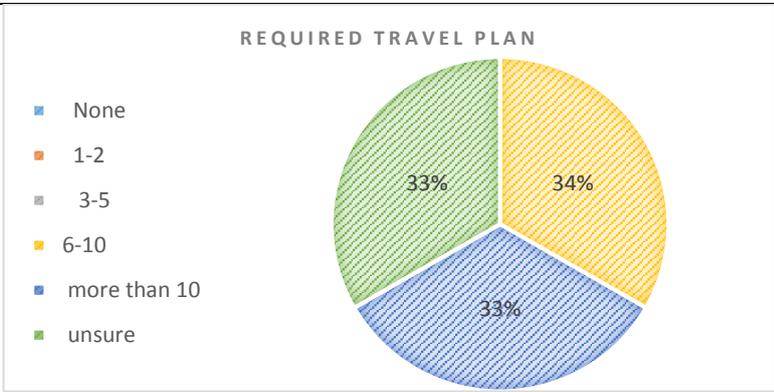
Table 12: semi-structured interview results (Excel).

	Questions	Results																																										
1.	Has your agency ever adopted a travel plan for any urban development?	 <p>A pie chart titled "TRAVEL PLAN" showing the distribution of responses to the question "Has your agency ever adopted a travel plan for any urban development?". The chart is divided into two segments: a blue segment representing "YES" at 67% and an orange segment representing "NO" at 33%. A legend to the left of the chart identifies the colors: blue for YES, orange for NO, and a small grey square for an unlabeled category.</p>																																										
2.	To what extent do you agree that the following mechanisms are effective in managing transport access in your designing an urban context?	 <p>A grouped bar chart titled "effective mechanisms" showing the number of respondents who agreed or disagreed with various mechanisms for managing transport access. The y-axis is labeled "numbers" and ranges from 0 to 2.5. The x-axis lists six mechanisms. The legend indicates five levels of agreement: strongly agree (blue), agree (orange), neutral (grey), disagree (yellow), and strongly disagree (dark blue). The data is as follows:</p> <table border="1"> <thead> <tr> <th>Mechanism</th> <th>strongly agree</th> <th>agree</th> <th>neutral</th> <th>disagree</th> <th>strongly disagree</th> </tr> </thead> <tbody> <tr> <td>Upgrading the...</td> <td>2</td> <td>1</td> <td>0</td> <td>0</td> <td>0</td> </tr> <tr> <td>Providing sufficient car ...</td> <td>2</td> <td>1</td> <td>0</td> <td>0</td> <td>0</td> </tr> <tr> <td>Providing new and/or ...</td> <td>0</td> <td>2</td> <td>1</td> <td>0</td> <td>0</td> </tr> <tr> <td>Providing a safe and...</td> <td>2</td> <td>0</td> <td>1</td> <td>0</td> <td>0</td> </tr> <tr> <td>Incorporating a mix of...</td> <td>2</td> <td>1</td> <td>0</td> <td>0</td> <td>0</td> </tr> <tr> <td>Developing and...</td> <td>1</td> <td>1</td> <td>1</td> <td>0</td> <td>0</td> </tr> </tbody> </table>	Mechanism	strongly agree	agree	neutral	disagree	strongly disagree	Upgrading the...	2	1	0	0	0	Providing sufficient car ...	2	1	0	0	0	Providing new and/or ...	0	2	1	0	0	Providing a safe and...	2	0	1	0	0	Incorporating a mix of...	2	1	0	0	0	Developing and...	1	1	1	0	0
Mechanism	strongly agree	agree	neutral	disagree	strongly disagree																																							
Upgrading the...	2	1	0	0	0																																							
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Incorporating a mix of...	2	1	0	0	0																																							
Developing and...	1	1	1	0	0																																							

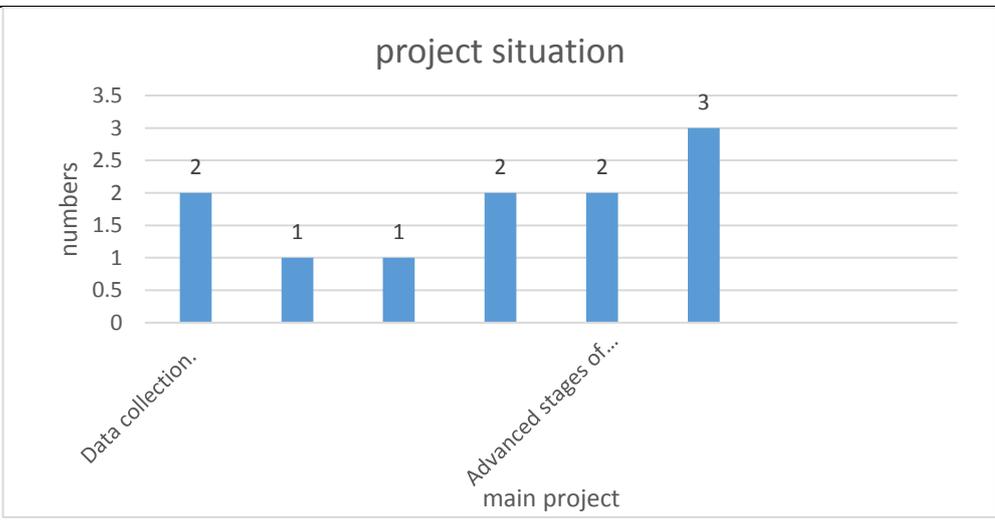
3. What are the motivations for your agency requiring travel plans for existing developments (tick all that apply)?



4. How many urban developments has your council required a travel plan for in the last five years?



5. Does your agency have a fixed guideway project in planning, design or construction? What comes closest to describing your situation?



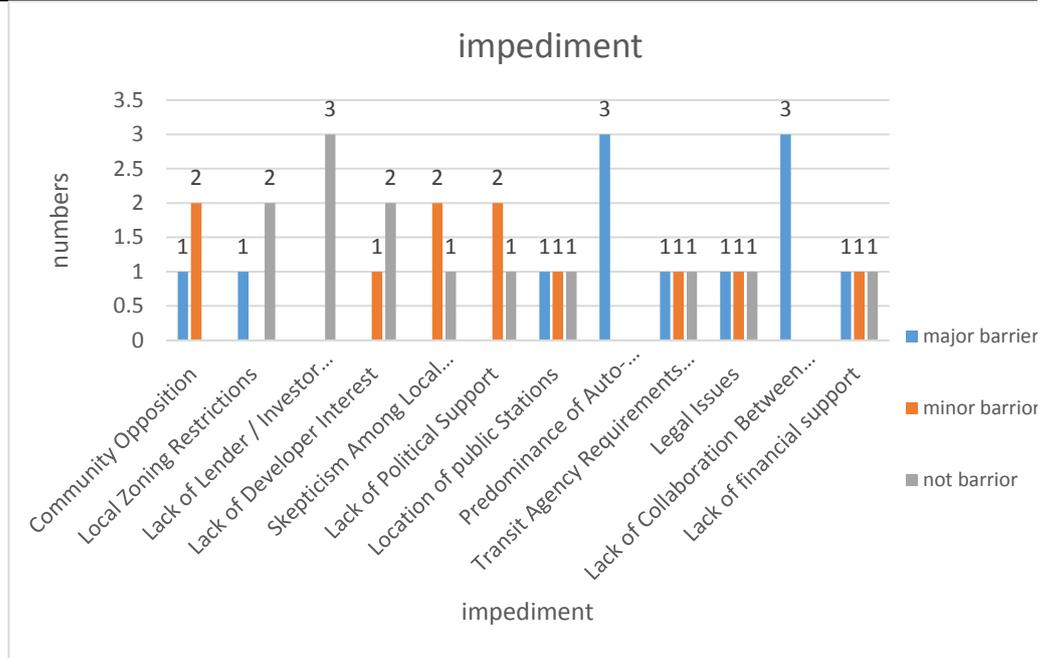
<p>6. What are the planning priorities that your agency takes into consideration while planning the land use?</p>	<p>planning priority</p> <table border="1"> <thead> <tr> <th>priority</th> <th>v.important</th> <th>m.important</th> <th>neutral</th> <th>l. important</th> <th>not important</th> </tr> </thead> <tbody> <tr> <td>Community needs...</td> <td>3</td> <td>0</td> <td>0</td> <td>0</td> <td>0</td> </tr> <tr> <td>Financial capacity</td> <td>1</td> <td>0</td> <td>2</td> <td>0</td> <td>0</td> </tr> <tr> <td>Available vacant land</td> <td>2</td> <td>0</td> <td>1</td> <td>0</td> <td>0</td> </tr> <tr> <td>To be typical to...</td> <td>1</td> <td>2</td> <td>0</td> <td>0</td> <td>0</td> </tr> <tr> <td>Solving existing...</td> <td>2</td> <td>0</td> <td>1</td> <td>0</td> <td>0</td> </tr> <tr> <td>Solving existing...</td> <td>0</td> <td>1</td> <td>1</td> <td>1</td> <td>0</td> </tr> </tbody> </table>	priority	v.important	m.important	neutral	l. important	not important	Community needs...	3	0	0	0	0	Financial capacity	1	0	2	0	0	Available vacant land	2	0	1	0	0	To be typical to...	1	2	0	0	0	Solving existing...	2	0	1	0	0	Solving existing...	0	1	1	1	0																														
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	<p>7. Problems related to Environment</p> <p>Topography, industrial areas that located in the center of the city and high density of population and traffic.</p> <p>8. Problems related to Society</p> <p>Urban pocket, multinationalism, and different cultures.</p> <p>9. Problems related to Services:</p> <p>No equal distribution of community facilities, need a certain level of population to perform facilities.</p>
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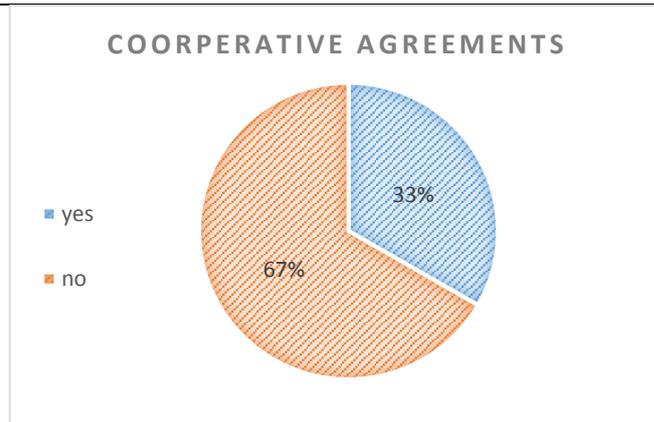
<p>10. Which, if any, national/regional government policies do your agency currently employ to encourage:</p>	<p style="text-align: center;">governmental policies</p> <table border="1"> <thead> <tr> <th>Policy</th> <th>Number</th> </tr> </thead> <tbody> <tr> <td>Mixed Land use</td> <td>2</td> </tr> <tr> <td>Land use segregation</td> <td>1</td> </tr> <tr> <td>Public Transportation</td> <td>0</td> </tr> <tr> <td>Enhance Road...</td> <td>0</td> </tr> <tr> <td>Walkability</td> <td>0</td> </tr> </tbody> </table>	Policy	Number	Mixed Land use	2	Land use segregation	1	Public Transportation	0	Enhance Road...	0	Walkability	0
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<p>11. Based on your experience, how important is each design element to encourage walkability and usage of public transportation?</p>	<p style="text-align: center;">design elements</p> <table border="1"> <thead> <tr> <th>Design Element</th> <th>v. imj</th> <th>m. irr</th> <th>neut</th> <th>l. imj</th> <th>not i</th> </tr> </thead> <tbody> <tr> <td>Variety of ground...</td> <td>0</td> <td>3</td> <td>0</td> <td>0</td> <td>0</td> </tr> <tr> <td>Raised street...</td> <td>2</td> <td>0</td> <td>1</td> <td>0</td> <td>0</td> </tr> <tr> <td>Outdoor seating...</td> <td>2</td> <td>1</td> <td>0</td> <td>0</td> <td>0</td> </tr> <tr> <td>Outdoor seating...</td> <td>2</td> <td>0</td> <td>1</td> <td>0</td> <td>0</td> </tr> <tr> <td>Well-lit public spaces...</td> <td>2</td> <td>1</td> <td>0</td> <td>0</td> <td>0</td> </tr> <tr> <td>Plantation</td> <td>2</td> <td>1</td> <td>0</td> <td>0</td> <td>0</td> </tr> <tr> <td>walls adjacent to...</td> <td>0</td> <td>3</td> <td>0</td> <td>0</td> <td>0</td> </tr> <tr> <td>Street awnings...</td> <td>3</td> <td>0</td> <td>0</td> <td>0</td> <td>0</td> </tr> <tr> <td>Large pedestrians! ...</td> <td>3</td> <td>0</td> <td>0</td> <td>0</td> <td>0</td> </tr> <tr> <td>Windows facing street</td> <td>0</td> <td>3</td> <td>0</td> <td>0</td> <td>0</td> </tr> <tr> <td>landscape design...</td> <td>2</td> <td>1</td> <td>0</td> <td>0</td> <td>0</td> </tr> <tr> <td>Lighting</td> <td>3</td> <td>0</td> <td>0</td> <td>0</td> <td>0</td> </tr> </tbody> </table>	Design Element	v. imj	m. irr	neut	l. imj	not i	Variety of ground...	0	3	0	0	0	Raised street...	2	0	1	0	0	Outdoor seating...	2	1	0	0	0	Outdoor seating...	2	0	1	0	0	Well-lit public spaces...	2	1	0	0	0	Plantation	2	1	0	0	0	walls adjacent to...	0	3	0	0	0	Street awnings...	3	0	0	0	0	Large pedestrians! ...	3	0	0	0	0	Windows facing street	0	3	0	0	0	landscape design...	2	1	0	0	0	Lighting	3	0	0	0	0
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12. Based on your experience, to what degree is each one of the following consider as a barrier to implement travel plans in the urban development?



13. Does your agency have cooperative agreements with any of the public agencies to promote sustainable transportation trends?



Discussion

Interviews results showed a high interest in the community needs from services and facilities but less interest on solving transportation problems. Besides, the results showed less importance in the public transit when planning a new development comparing with high importance in providing other facilities such as school or parks. For pedestrian environment and cycling tracks, it is not important in the planning process. The most problems that facing the agencies are. For transportation issues is the accessibility to other emirates and how much it is convenient with the land use. In addition, it found that planning of urban context play an important role to encourage walkability, all of the answers agree with studying the accessibility of the road network and providing shed and verity in the ground texture or providing lighting. It found that the most barrier to implement any travel plan is the Predominance of Auto-Oriented Land Uses and the corroboration with other agencies.

These results show a gap between the stakeholder and the residents; this conflict sometimes is because of the policies implementing or because the methodologies of considering the priorities. However, the results show high awareness of the important role of people opinion and their needs in any urban planning process. Besides, the corporative link between different agencies needs more concern by having a system that joins all available data from different parts to gain the general benefit to the country.

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4.6.UCL Depth map results and analysis

The work starts applying a graphical representation of the selected area. By generating an axial map to analyse the road network. The result as shown in figures (4.22-4.24) can present as a graph. The line represents the streets with a different colour to present a range of usage. The analysis of this study based on three approaches; integration, connectivity, and choice.

- Integration

Integration shows the distance to each another segment in the road network by using short paths. Also, it can predict the pedestrian use of the roads. More integration means easier reaching of the streets that make it more popularly in use. Figure (38).



Figure 38: Integration approach in the selected area (UCL depth map software).

In the chosen area, the most integration appears in red; less integration shows in blue. It can present the major and public movement with high efficiency.

- Connectivity

It can describe the depth distance that considers one of the most analytical methods in space syntax. It measures the linear distance between centers of points to all other center points in the streets. The lowest value reflects the nearest to other points figure (39).



Figure 39: Connectivity approach in the selected area (UCL depth map software).

- Choice

It can be similar to water flow in the street. In each intersection, this flow divided to continue to flow in the network until it reaches all the segment of the network. The street with higher values shows a higher flow. It can predict car traffic flow in the street network figure (40).



Figure 40: Choice approach in the selected area (UCL depth map software).

4.7. ENVI-met results and analysis

For the model simulation, the heart of Sharjah transformed into a grid model of 100x100x40. With a rotated 11 degree of the north. The simulation input data based on the climatic data from climate consultant tools of UAE based on ASHRAE standard 55-2004. Table (13) shows the input data at the same day of the site visit. The output of ENVI-met then compared with the climatic data that recorded from the location in 14th of June 2017.

Table 13: input data used for ENVI-met (climate consultant).

parameter	value
<i>month</i>	June
<i>day</i>	14
<i>hour</i>	12:00 PM
<i>Dry Bulb Temp</i>	39° c
<i>relative Humidity</i>	42 %
<i>Wind Speed</i>	4.1 m/s
<i>Wind Direction</i>	300

The output of the model simulation based on 1.0 m vertical resolution, meanwhile the data that recorded from the location observed at 1.2 m above the ground. As shown in figure (41) the comparison between the observed data and ENVI-met average data in temperature parameter was close to each other. This comparison takes place in four hours from 11:00 am to 2:00 pm to get accurate data from ENVI-met software. As shown in the graph the temperature reaches its peak point of 41° c at 2:00 pm according to ENVI-met, which is close to 39° c of site record.

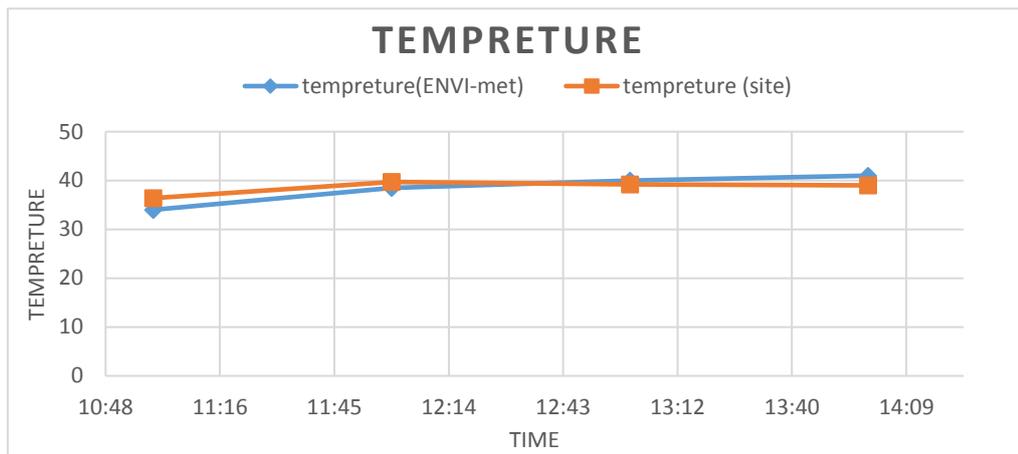


Figure 41: comparison between dry air temperature recorded and ENVI-met.

Relative humidity in figure (42) shows the slight difference in reading between the observed data and ENVI-met data. However, at 1:00 pm the reading is almost close to each other for 58% in ENVI-met and 59.8% in the site reading. The Large difference appears at 2:00 pm for 11 percent between the two reading data, this changing can relate to the wind speed change and the closeness to the sea in the selected location.

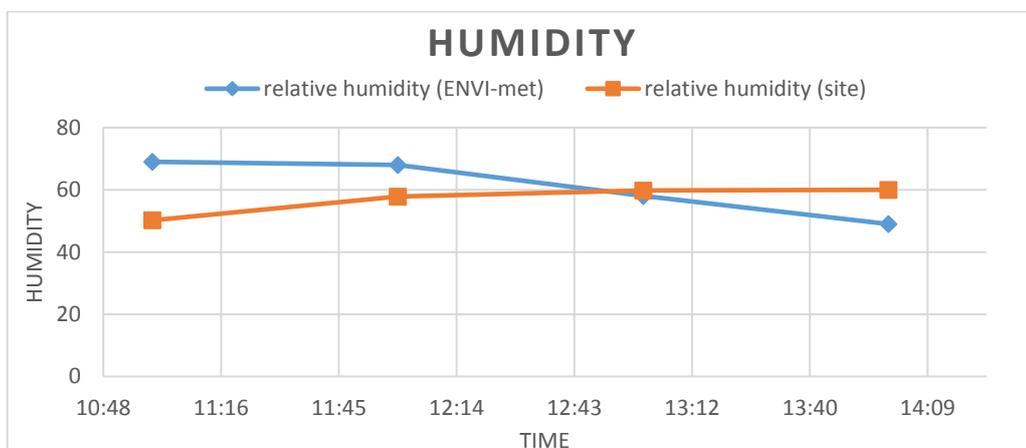


Figure 42: comparison between relative humidity recorded and ENVI-met.

Figure (43) shows wind speed, which gives a high difference between measured data and ENVI-met data. It reaches to 2.74 difference at 1:00 pm of that day. Moreover, the minimum difference at 12:00 pm for 0.60. This change due to the nearest to the sea and the urban structure of the building and the street orientation. All these factors can affect climatic data on a wide scale.

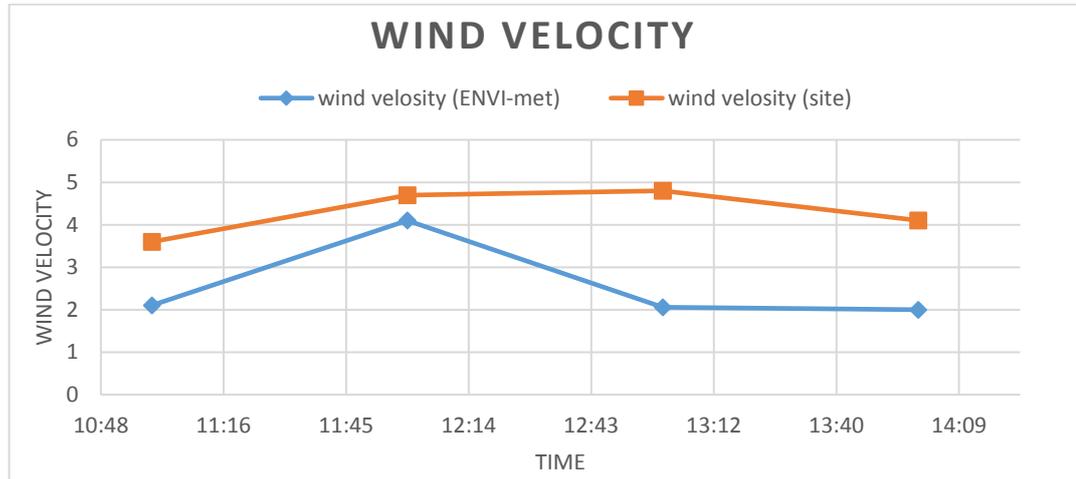


Figure 43: comparison between wind velocity recorded and ENVI-met average.

The mean radiant temperature (T_{mrt}) is one of the most influential parameters that affect the human thermal comfort by controlling energy balance. Therefore, an ENVI-met model of (T_{mrt}) generated to specify the area that needs shade in the outdoor environment. As in this research, ENVI-met presents a valid and reliable data through comparing the collecting data from the site and the generated model at ENVI-met. Although many studies mention ENVI-met software or use it to calculate (T_{mrt}) like (Elnabawi. al, 2015), (D'Souza, 2012) and (Kantor. al, 2011) and consider it a very useful tool for predicting the climatic issue. Still, it has some performance obstacles; such as a long time for simulation and the length change of the radiation wave. The result shows a high mean radiant temperature in the location, which exceeds 60° C in the middle area of the site. It reflects the broad impact of the surrounding on the thermal comfort of people and affects their attitude toward their environment. Therefore, any planning process should take into consideration microclimate issue amongst any landscaping or urban design. Figure (44) shows temperature profile of two different time 11:00 a.m. and 2:00 p.m. The highest surface temperature was found in the unshaded asphalt all over the periodic time of testing. It get more than 43° C at 2:00 p.m. shaded asphalt and concrete pavement still had a high

surface temperature comparing with other material. It hit the 39 C at 2:00 p.m. and 33 C at 11:00 a.m.

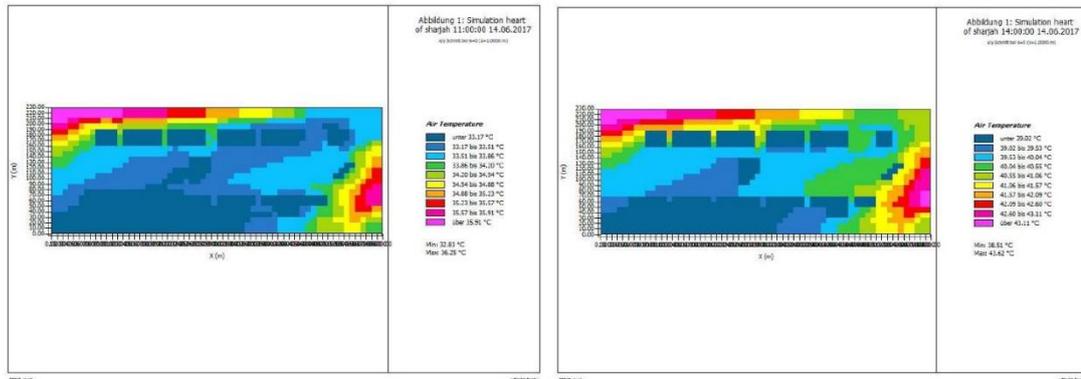


Figure 44: ENVI-met comparative study of temperature (author).

Figure (45) confirmed the mean radiation temperature that reflect the emissivity from long wave radiation. The highest values surrounding the building that range between 59.49-61.20 C confirms that the hard surfaces that exposed to the sun absorbs heat and emits more radiation to other surrounding environment, which need a high attention when choosing streetscape materials.

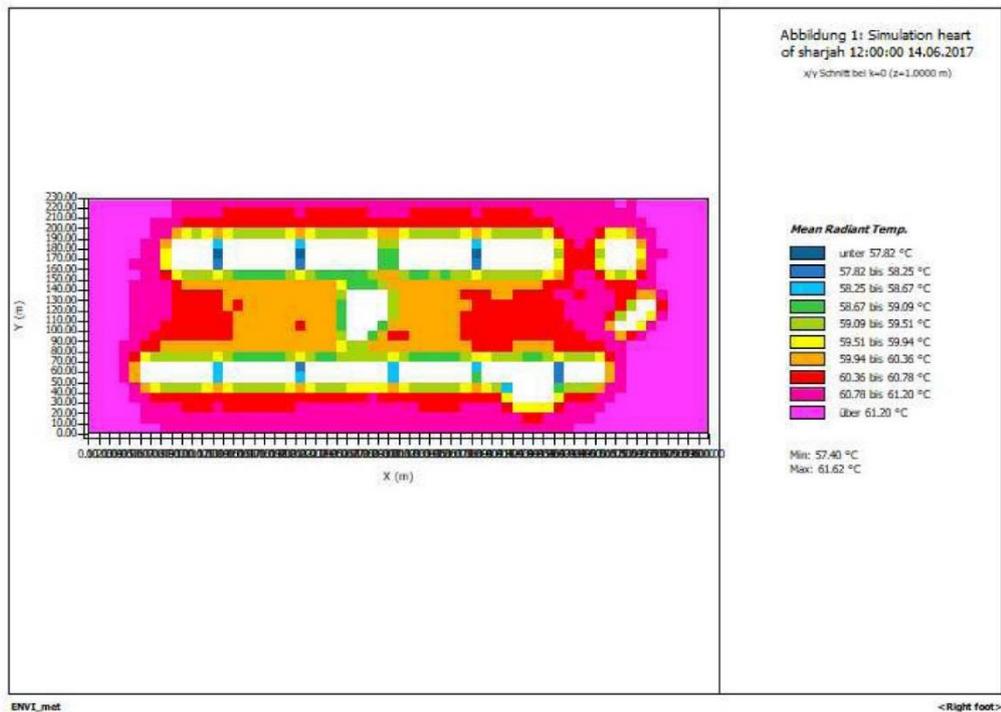


Figure 45: MRT at 12:00 p.m. generated by ENVI-met (author).

Average relative humidity (RH) at 11:00 a.m. is 66-71%. At 2:00 p.m. (RH) reduced to 49-50%. This vary in (RH) effected by many factors such as airflow and wind speed as shown in figure (46). Relative humidity affected by temperature. It has inverse relationship. By increasing the temperature, relative humidity decrease. On the other hand, urban form and the topography of space and nearest of the water can affect (RH) as discussed in the (4.8) section. In the middle of building context, (RH) has smaller value comparing with outer parts of the context and this appear in all testing hours. This give a good proof of urban form impact on the (RH).

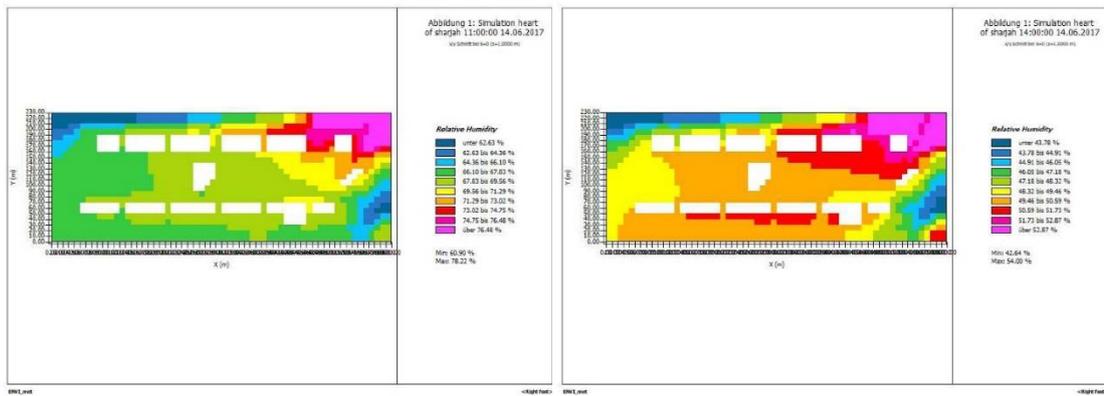


Figure 46: Relative Humidity generated by ENVI-met (author).

Figure (47) presents wind speed at 12:00 a.m. wind speed does not change all over testing hours. The average of wind speed is 2.07 m/s. urban form affect wind speed by increasing it in corridor spaces to reach 3.26 m/s. especially if the buildings oriented to the seaside.

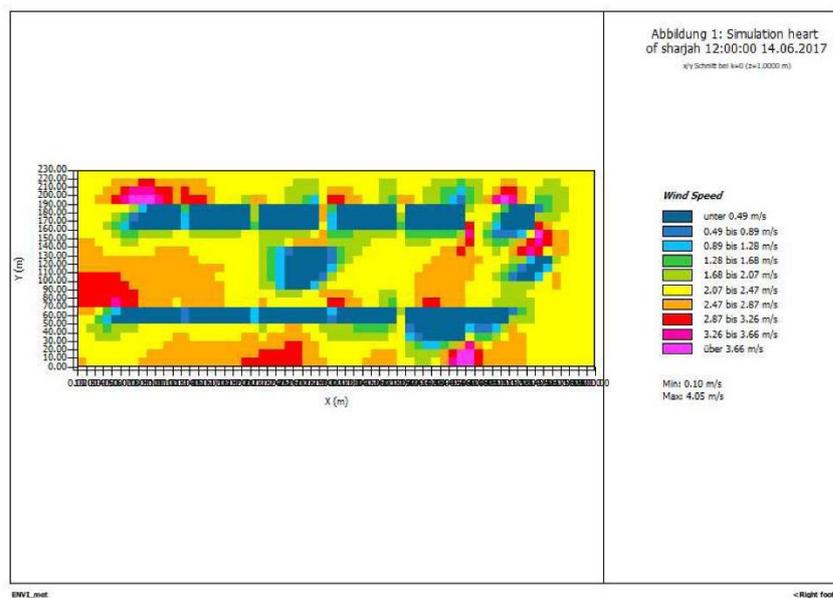


Figure 47: wind speed generated by ENVI-met (author).

4.8. Software discussion

The difference in building height help in controlling airflow (Ng, 2009). Ng, in his study, pointed to vary the heights of constructing and to decrease the height towards the direction of the wind to get the benefit of the prevailing wind. However, if this not happens, he suggested having different heights rather than a uniform level that gives a good air ventilation figure (44). Besides, the Variety of building heights provides shading to other spaces.

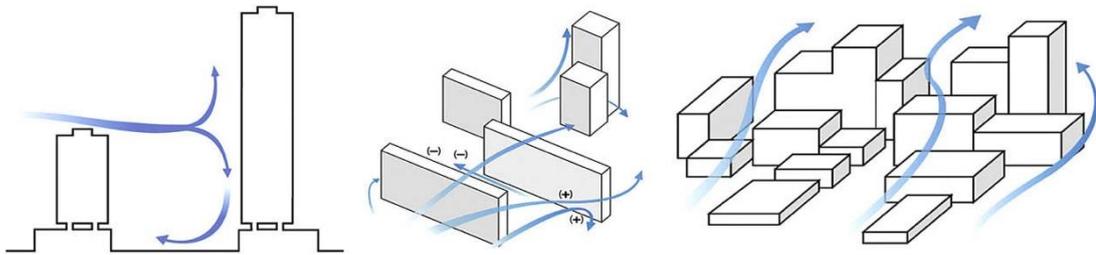


Figure 48: Different building height affects wind movement (Ng, 2009).

The temperature increased by 6 degrees from 11:00 to 14:00 but the location of this variation affected by the urban development. The shaded areas still had the lower temperature compared to other exposed locations. In addition, the area covered with vegetation or soft landscape had the lowest temperature. Moreover, humidity values reduced by 15% from 11:00 to 14:00 this makes the climatic condition for walkability or outdoor activity at this time is hard. - based on own experience when I took the climatic measurements, walking for 100 m was fatiguing at that date and daytime. – This time of the day is the rush hour that employees finish their work or work shifts. Therefore, the place was full of cars that are moving with little pedestrians on the streets. Wind velocity can be affected by the orientation of the building and the nearest to the sea. As mentioned above of Ng, (2009) study that proves the ability of urban design to control air ventilation by the different way one of them referred to above (Variety in building height). Other strategies are narrower streets, building angle and orientation and creating paths between constructions.

Urban development and direction play a fundamental role in changing people attitude toward their traveling mode. Therefore, many factors can affect ENVI-met parameters including building height, shading, and building orientation. In the selected area is oriented to the east-west. Form a row of building with different height centralized with a center space covered with stone and asphalt with some greenery scattered in the center area. Moreover, a high use of vehicles all the day, as this area,

is having a mixed land use (offices, commercial and residential). However, the opening to the sea with the linear shape or 30 degrees will maximize the breezes due to sea cooling and sun warming effects figure (45) and figure (46) (Ng, 2009).

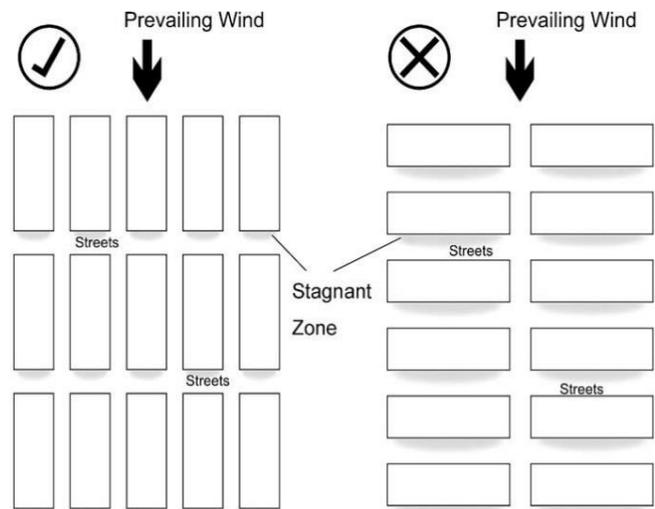


Figure 49: Orientation of building to gain prevailing wind (Ng, 2009).

The best practice of orienting the building to maximize breezes penetration inside urban context is keeping open paths between building with a low or medium height in the first row as shown in figure (46). Then maximize building height in the backside of water-front (Ng, 2009).

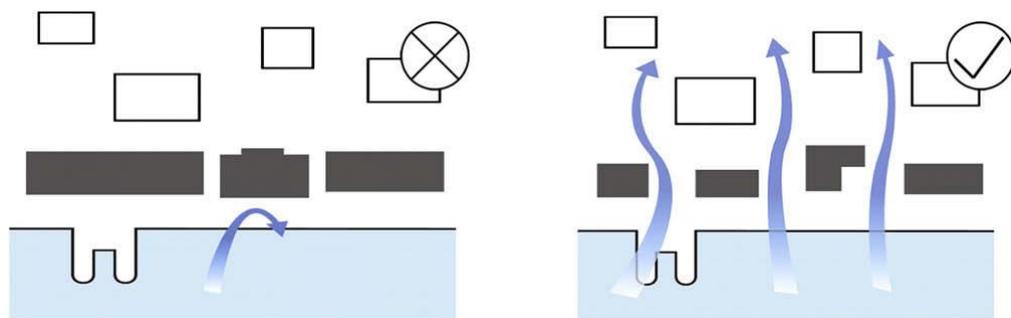


Figure 50: The effects of nearness to the sea and side path on wind movement (Ng, 2009).

4.9.Outcome

This chapter has the results and analysis of travel behaviour of people within a specific area on Sharjah city. In addition, analysis to the urban context of the area and climatic condition of this area. Through analyzing the selected site by using different software such as ENVI-met and UCLdepthmap. In addition, studying the urban potential of the location (services, land use and street structure) by presenting different site analysis based on data from authorized agencies. Moreover, by analysing the data from questionnaire, it found a high demand on the services within the walkable area. Besides, rethinking in the design of the streets to make it connective and accessible for integrated of different travel mode for pedestrians and public transportation or private car.

Nearly 42% of respondents not satisfy of the public transportation accessibility. In addition, the high rise in Sharjah city population from 615,705 persons in 2005 to 1,274,749 person in 2015 (Sharjah census, 2015) should have attention to control people demands. The Surveys and interviews give indicators to the most critical issues that need a special concern. First, people attitude need to integrate with planning process to reflect a reliable urban design, and to link the gap between stakeholders and people demands. Second, public transportation need more enhancement in the region by applying more fleets and information, 36% found that public transportation lack to the informative approach so people can know or use it, studying a proper timing for commuter and good design of street structure to absorb vehicle and pedestrian's capacity. Third, enhance the technology and smart method to reduce the impact of negative practice of using vehicles. Alternatively, encourage using environmental friendly travel methods such as electric vehicle or hybrid cars. This suggestion comes from people attitude, which 82% agree with using environmental friendly travel choice. Urban form can affect the decision of people when choosing their travel mode. The way of building constructed or street structure can affect the climatic condition that affect people comfort. 78% aware about the role of walking and cycling on the environment but still the same people have a high tendency to use private car in their trip.

Based on the reviewed literature at chapter 2, this attitude could be for many reasons, saving their time and money or the lack of public transportation or the ability of street for walkability or cycling or for climatic condition in the region or maybe for self-selection and safety factors. Wherever the reasons behind this attitude, urban planners and developer should consider every factor and study each relationship to present a high quality of urban design that, encourage people to walk and do other activities in a healthy environment.

Chapter 5: conclusions and recommendations

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5.1.Introduction

This research has investigated the relationship between urban form and travel behaviour in a microclimate scale. The primary motivation of the study is to provide the richness of a case study scenario to underpin the impact of the social construction of the urban form and provide a significant understanding of urban form and its implications on the environment. Moreover, how people attitude expectations influenced “lived experience.” On the other hand, it provides a basic tool to understand the travel behaviour of different level of the community as it will hold in the United Arab of Emirates. It has a variety of culture, religion and education background.

This chapter will include a summary key finding based on the results from different methods to demonstrate how the research aim and objectives have been met. A general conclusion of the research is also presented followed by research limitations and recommendations.

5.2.Conclusions

As presented in chapter 1, this research aims to measure the effect of the urban form of people attitude and travel behaviour in micro planning development. A number of the investigation objectives were addressed in chapter 1 to help to reach the aim of the study. Figure (47) present the structure of the study.

Different methods were used to investigate in the research objectives. Using survey and semi-structured interview used to explore the relationship between urban form and travel behaviour. Moreover, to study the main parameters that affect implementing travel behaviour in the planning process. Computerized technique by using UCL depth map helped to assess the current practice of travel behaviour in a neighbourhood scale for the case study. ENVI-met were used to evaluate the current urban form to enhance the climatic condition to reach climate comfort. For evaluating a different practice for travel behavior in various countries in term of different urban context, an extensive literature review on this topic were applied.

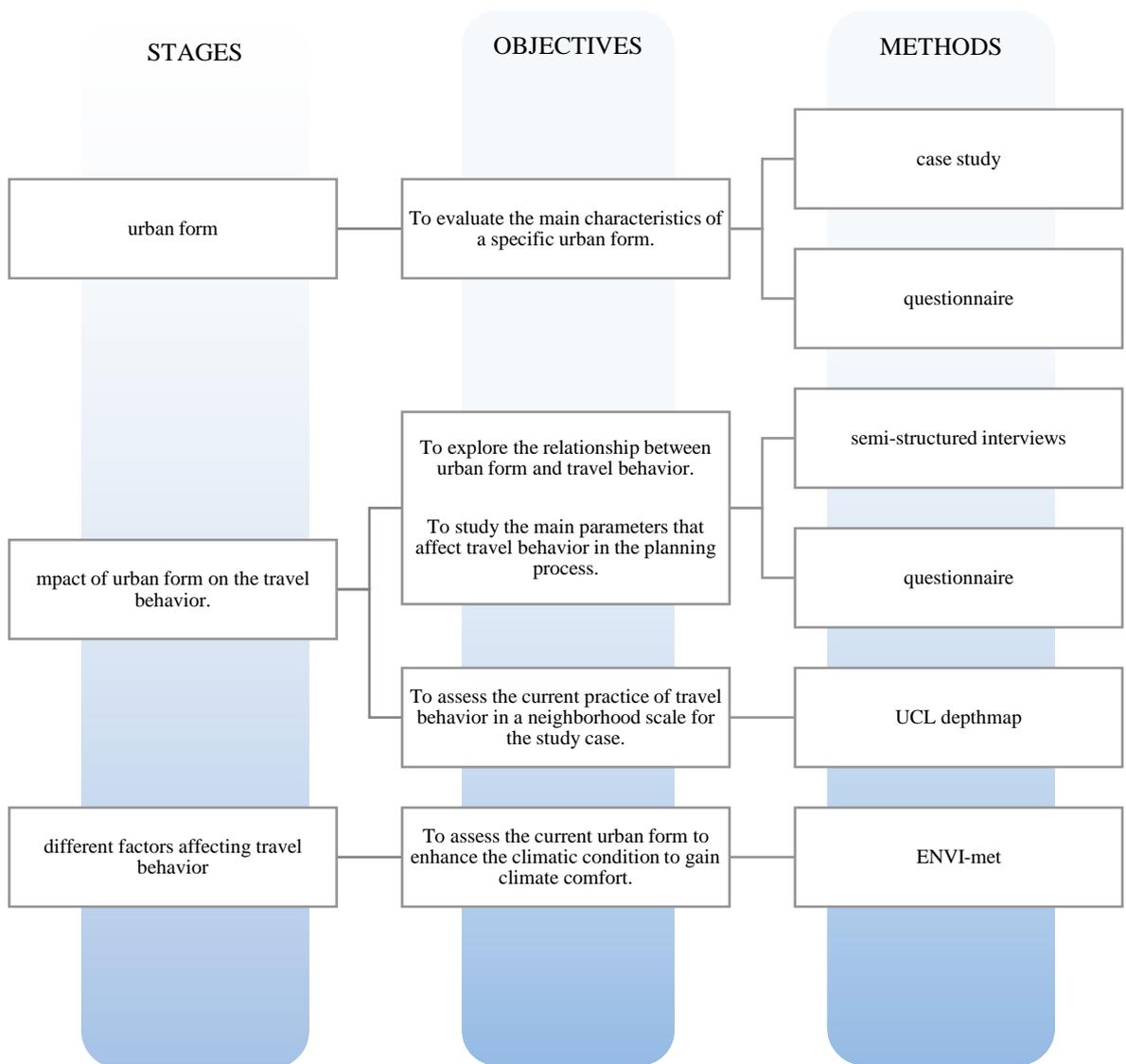


Figure 51: Structure of the study

The main structure of the study is exploring the effectiveness of the urban form in a planning context. Three main stages were followed to reach this goal. First stage interests on the existing urban form of a particular area so, Marija neighbourhood in Sharjah city was chosen as a case study. Through this case, study an investigation of the major characteristics that shape Marija urban form. The main finding of a different analysis that this area has a traditional form in some location and new form with adjacent to the old part. With mixed used vary between offices, commercial,

residential, cultural and tourist location that apply difficulties and opportunities at the same time. The Difficulties are studying the parameters and facilities of the location, opportunities in studying different form at the same place and historical changes of the area. Road network does not design for pedestrian and discouraging walkability. At the same time, not enough car parking is available at the location. Moreover, questionnaires were used to get more description of the selected urban form from different perspectives including road network, walkability, material and structure of the roads, outdoor spaces and safety concept in the space. The results obtained from this questionnaire showed that despite the availability of outdoor spaces and the new features such as restaurants and cafes, and cultural locations, the location still experiences a little walkable capacity in the streets and open spaces. This lead to study people travel behaviour and if the urban form affects this attitude or other factors influence this stance.

In the second stage of this study, more focusing on the impact of urban form on the travel behaviour. This need to work in two directions. First, by studying the current practice of the trip behaviour of the case study. Second, by studying the main parameters that affect travel behaviour in the urban context. For the first direction, questionnaires were developed to measure the attitude of people toward their traveling and trips. Moreover, simulation software, UCLdepthmap was used to present the current road potential by implementing space syntax analysis to the selected area. The results showed a high use of private vehicles for different trips. The central street of the location does not have a good accessibility or connectivity, so the choice to walk on these streets is low. On the other hand, the results show less interest in public transportation 37% found public transit performance is not good. The second direction was reached by questionnaires that reflect the attitude toward urban features at the location. The results showed dissatisfaction of the streets furniture or structure that discourage them from walking or cycling. Safety on the road can improve by good urban design (Welle and King, 2014) in the study 44% found their streets are not safe for their children. In addition, semi-structured interviews with authorized people who are responded for putting policies and regulations of urban planning at the first stage of the urban process. Interviews results showed a high interest in the community needs from services and facilities but less interest in solving transportation problems. Besides, the results showed less importance in the public transit when

planning a new development comparing with high importance in providing other facilities such as school or parks.

The last stage was dedicated to investigating in other factors that affect travel behavior besides urban form. The analysis carried on the climatic condition of the location by using the ENVI-met software. Moreover, it found that the climatic condition affects the people choice of their travel mode. High temperature and humidity can decrease people comfort. As a result, the increasing of the integration between urban design and climatic condition to mitigate discomfort of people can positively impact the travel behaviour to use different transportation modes like the public, walk or cycling by increasing the accessibility of transportation.

Despite the high investment in improving the public transport network in Sharjah and the large concern in providing convenient services and facilities, currently, the majority of people rely on their private car. This trend occurs due to the low integration of the public transportation or another mode like walk or cycle with the local urban community, low informative knowledge about public transportation and insufficient accessibility to public transportation. The low price of fuel in the region that make it the easiest and cheapest alternative to different transportation mode. In addition, high quality of life style that increases car owners and users in the area. Besides, social restrictions such as gender separation or women limitation of outdoor activates. Moreover, the climatic condition in the region (high humidity and high temperature) most of the year that maximize car dependency rather than walkability and using other transportation modes. Behavioural change due to psychological factors or self-selection is one of the critical variables.

Overall, it can be noted from this study that travel behaviour can influence by different variables, in this case, urban form and climate condition can be the effective variables that need to integrate. This integration would not be easily implemented since it required an involvement between stakeholders and transportation behavioural. That means it takes extensive resources of time and money. Shifting towards more proactive planning process need money to implement. Moreover, considering that building industry and transportation takes considerable time. However, given that these strategies can imitate car use and encourage other transportation modes that help in protecting the environment should recognize especially in the cities that suffering from transport pressures.

5.3.Limitation and challenges

Transportation studies are complex due to the various parameters and correlation with other fields such as urban planning, social studies, environmental and economic studies. Moreover, transportation development needs a long time to gain the results. That makes the study rely on the current situation to predict the future. That reduces the validity of any simulation since it would not implement as it once been scheduled. Therefore, it should concern that any change in the community development can alter the evaluation in this study. For studying the climatic condition, also it required more time to analyze during the winter since it performs in one climate (summer). That could add more data to the evaluation since people could change their behaviour according to the weather condition. High temperature and humidity when taking the measurement were difficult to handle.

Questionnaire faced many struggles to perform since it needs a lot of time and effort to finish it all. It requires many visits to the location in different timing. Besides, not all of people were welcoming to answer from the beginning or after few questions. Therefore, many surveys were neglected according to uncompleted answers. Besides, some direct question should be implemented in the questionnaire such as the impact of climate on people attitude, the preferable urban form in the location that encourage walking. These direct questions could reduce the time of investigation instead of finding the answer by using indirect questions. For semi-structured interviews, it was designed to meet the authorized people who in charge of the policies and regulation of urban planning and transportation system. Unfortunately, meeting them was not easy, and some of them were not possible to interview, since the study conducted in the summer time where most of them were on vacation or outside of the country.

The different targets and destination in the study could be a restriction to specify the behaviour in more accurate since the study presents a range of ages with different interest and trip destinations (school, work, shopping and so on). The questionnaire could be more suitable if it has a focus target of destination.

For simulation and analysis software process, the procedure of modelling and operating in ENVI- met and UCL depth map and questionnaire analysis by SPSS software needs time to study these soft wares since there was no previous experience. Moreover, the simulation run times were extended especially for ENVI-met since the

results could not read until it finished the whole simulation. Therefore any modification needs to repeat the whole simulation.

5.4.Recommendation

Sharjah city is suffering from adverse effects of the traditional transportation system. This situation required an efficient and smart planning to solve current problems. Transportation development system that stands on dynamic and fundamental parameters can face these problems such as high vehicles dependency. Moreover, all other related problems including air pollution, congestion, and unaffordable housing system. Some solutions to these problems are to involve smart urban form parameters include higher density development, designing for pedestrians without excluding the auto. The study presents the great use of vehicles Meanwhile it shows a strong environmental awareness. These results reflect the urgent need to find suitable planning methods that support this attitude toward the environment and reduce the use of vehicles. This implementation requires factors to success like local and governmental policies, reliable and proactive institutions, individual supportive, high quality of transportation services, availability and attractiveness of land development and parking management. Urban process in Sharjah city needs to develop actions including, a collaboration between urban planning and transportation, enhancing the interaction and community sharing, having updating database, using technology to save time and effort, planning for emergency requirements. Current Public participation needs to improve through, an interaction of different parties of communities to express their attitudes and requirements, accepting new urban planning methods that encourage walkability and public transportation. Using these methods and dynamic parameters could enhance travel behaviour in the region.

Researchers should be integrated with digital tools that give accuracy, saving time and effort and provide acceptable results and predictive information. Make a spatial analysis by Applying space syntax analysis using UCL Depth map that depends on the urban planning data of street and land use. Moreover, it connects urban form with travel behaviour in a dynamic way. Besides, using ENVI-met software to predict the climatic condition can play a significant role in the urban process. As shown in the study the role of different urban elements in enhancing climate comfort and encouraging walkability, so it is recommending to apply pedestrian shaded paths

and integrated plantation with the construction, using a variety of grounding and materials.

More concern for economic analytical studies to recognize the benefits and shortcuts of any urban process. That reveal the importance of travel behaviour studies to give indicators for people attitude toward travel modes that need to invest on and other travel modes that require less investment. Keeping in mind the long-term goals, slow changing in urban form and transportation industry demands of time and money.

For the future investigation, several topics can develop from studying travel behaviour. These topics can define in four perspectives:

- *Time perspective:*
Examine the impact of climate condition on travel behavior in a different time in the year.
- *Space perspective:*
A comparative Study of each urban form and streets pattern separately and its impact on travel behavior.
- *Personal perspective:*
Studying the personal capabilities, attitudinal and habit factors that influence travel behavior since this study focus on the external factors.
- *Restricted perspective:*
Building an updated database and regulation in the urban planning process to transform from traditional system to smart system.

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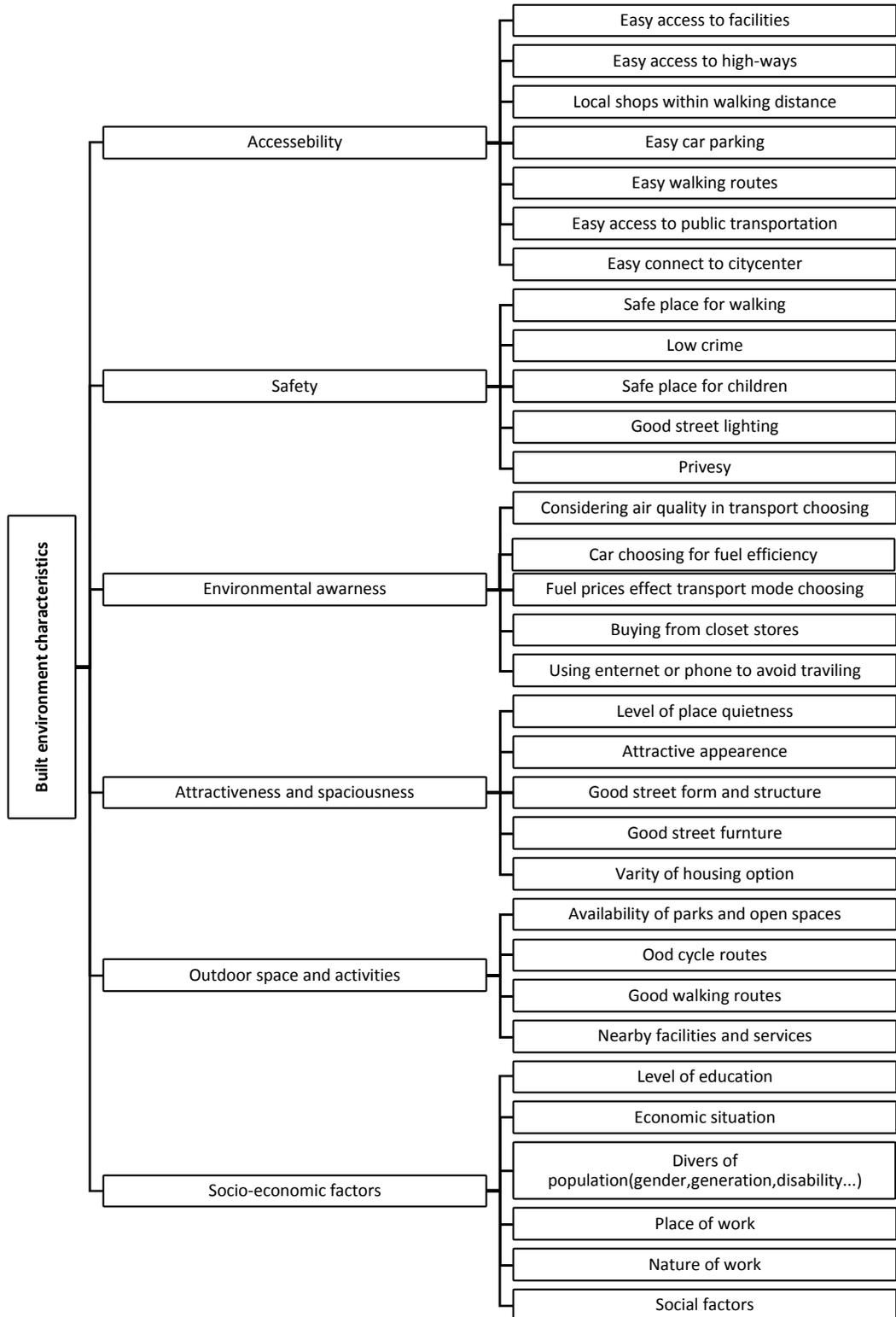
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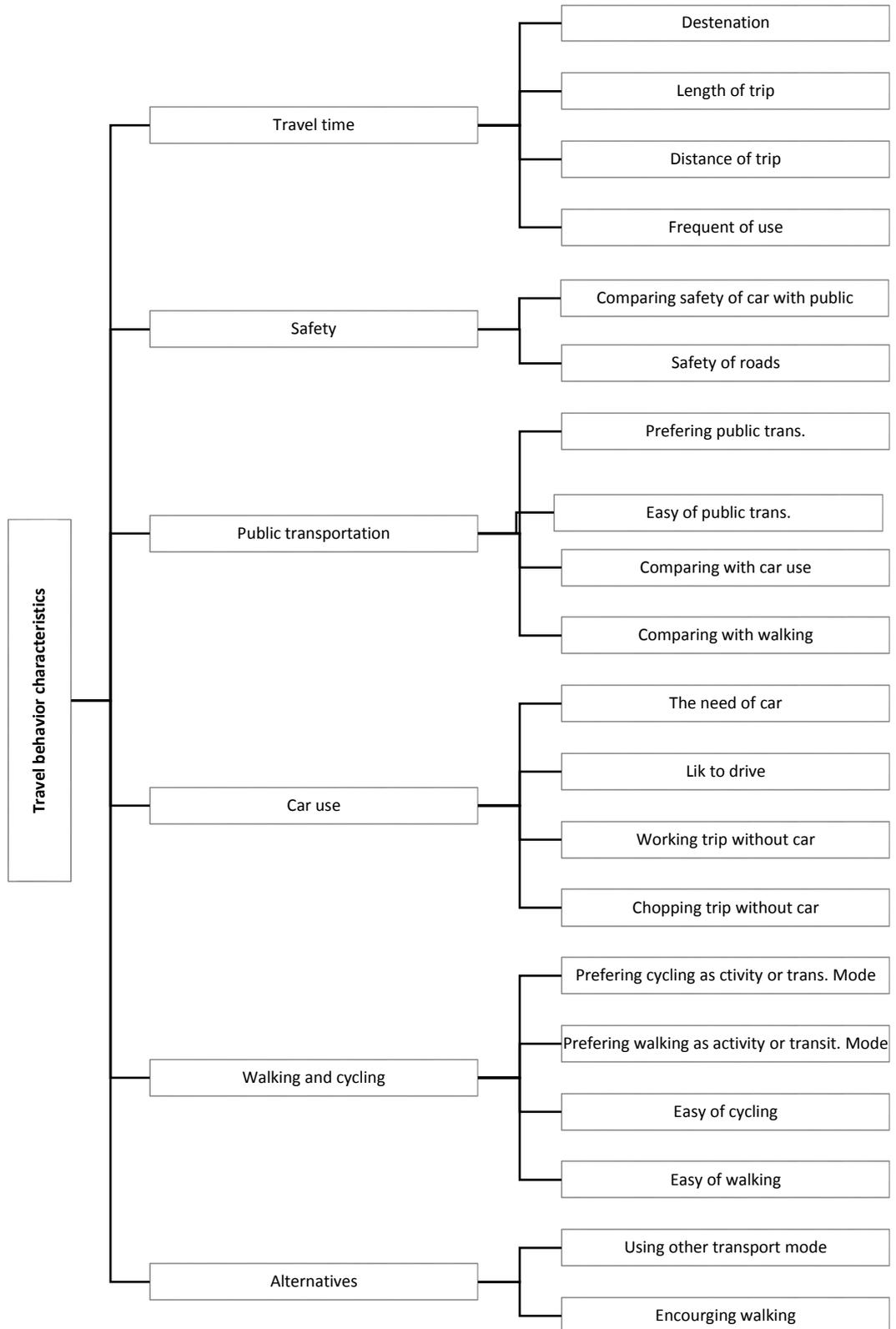
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APPENDIX

Appendix A

Survey structure





Appendix B

Local community questionnaire:

Local Community Questionnaire- Sharjah City

The correlation between urban form and travel behavior to have energy efficiency

This thesis prepared in partial fulfillment of the requirements for the degree of Master in Engineering. The researcher seeks to build a sustainable and energy efficiency that based on the term travel behavior, and Sharjah city chooses to be as an implementation area. The Study depends to a large extent for your help and support. Therefore, the researcher would ask you to answer all questions of the following structured interview. The researcher is very sure that all of your answers will distinguish by literalism, objectivity, and accuracy. Your high-quality answers will define indicators that support the approach and help to identify priorities. Finally, make sure that all answers will use for just educational and research purposes.

Thank you

Researcher: Heba Amin

Nofal

A. GENERAL INFORMATION

1. Gender:

- Male Female

2. Age:

- Less than 18 19-26 27-45 46-65 more than 65

3. Educational degree:

- Less than high school High school Diploma Bachelor's degree Post graduated

4. Job:

- Employee (determine) Student Private Business Housewife Without work others

5. Workplace:

- Inside neighbourhood outside neighbourhood outside city, others (determine) _____

B. TRIPS AND TRANSPORTATION

6. How much time do you spend to arrive your workplace?

- Less than 15 min. 15-30 min 30-60 min more than 60 min.

7. How long can you walk on feet to the work, home or any other trips?

- 5min (determine) 10min 15min more than 15min others

8. What was the distance of your last moving (shifting)?

- Within the same street another emirate within same neighbourhood within same emirate

9. Please tick (1) for the main mode of travel you use most frequently for following activities. And (2) for the less common mode of the journey or as an alternative mode. If an activity does not apply to you, please tick “not applicable”.

<i>Most frequent travel mode</i>	<i>Car</i>	<i>Bus</i>	<i>Taxi</i>	<i>Bicycle</i>	<i>Walk</i>	<i>Other</i>	<i>Not applicable</i>
<i>Shopping</i>							
<i>Work trip</i>							
<i>Local leisure</i>							
<i>Visiting families and friends</i>							
<i>Taking children to school or nursery</i>							
<i>Another local trip</i>							

C. ENVIRONMENTAL AWARENESS

10. Please tick on your agreement or disagreement to the following questions.

<i>statements</i>	<i>Strongly agree</i>	<i>agree</i>	<i>neutral</i>	<i>disagree</i>	<i>Strongly disagree</i>
<i>Using public transport will help to tackle problems like climate change or air pollution.</i>					
<i>Do you think that depending on public transport can contribute to solving the fuel problem?</i>					
<i>Walking/cycling reduces negative environmental impact</i>					
<i>I consider fuel efficiency when I choose my car</i>					
<i>I use telephone and the internet to buy things or buying things from closet store to avoid traveling</i>					
<i>In the ideal world, I will use the environment-friendly choices of traveling</i>					
<i>Cars are the most cause of hearing pollution</i>					

D. TRANSPORTATION AND URBAN FORM

11. Please tick on your agreement or disagreement to the following questions.

<i>questions</i>	<i>Strongly agree</i>	<i>agree</i>	<i>neutral</i>	<i>disagree</i>	<i>Strongly disagree</i>
<i>Do you agree with the idea of existing all educational, commercial, administrative, health and recreational services in your area?</i>					
<i>Do you think that direct connection to your area to the city center and highway may have efficient transportation system?</i>					
<i>Do you think that your area has easy access to the community services?</i>					
<i>Do you find it easy to access to public transportation in your area?</i>					
<i>Do you find your area is safe to your children on roads?</i>					
<i>Is the idea of afforesting, lighting, shading and furnishing streets encourage you to walk/cycling?</i>					
<i>Do you find the streets in your area have a good structure to encourage you for walking/cycling?</i>					
<i>Do find your area encourage you to spend more time in outdoor space?</i>					
<i>Do you find any difficulty in the park your car in your area?</i>					

E. TRAVEL ATTITUDE

12. Please tick on your agreement or disagreement to the following questions in **your district**.

<i>statements</i>	<i>Strongly agree</i>	<i>agree</i>	<i>neutral</i>	<i>disagree</i>	<i>Strongly disagree</i>
<i>There is a good level of information about public transport</i>					
<i>Public transport is affordable and good value</i>					
<i>Using public transport is the safest travel choice</i>					
<i>Increasing road tax can encourage using public transportation.</i>					
<i>Reducing car use is not an individual's responsibility</i>					
<i>Giving buses priority on the roads</i>					
<i>Do you think the idea of encouraging the walking and using public transport can improve the social relationship between residents?</i>					
<i>Do you think that public transport is satisfying with disabled people?</i>					

Appendix C

Semi structured interview:



Authoritative and official Local Agencies Semi-Structured Interview

The correlation between urban form and travel behavior to have energy efficiency

This thesis is prepared in partial fulfillment of the requirements for the degree of Master in Engineering. The researcher seeks to build a sustainable and energy efficiency that based on the term travel behavior and Sharjah city is taken as an implementation area.

The Study depends to large extend on your help and support. Therefore, the researcher would ask you to answer all questions of the following structured interview. The researcher is very sure that all of your answers will be distinguished by literalism, objectivity and accuracy. Your high quality answers will define indicators that support the approach and help to identify priorities. Finally, make sure that all answers will be used for just educational and research purposes.

Thank you

Researcher

Heba Amin Nofal

A. Introduction

i. **Agency / Jurisdiction:** _____

ii. **Person Completing Survey: Name:** _____

Title: _____

Phone: _____

Email: _____

B. Definition

1. Has your agency ever adopted a travel plan for any type of urban development?

- Yes
- No
- Unsure

2. To what extent do you agree that the following mechanisms are effective in managing transport access in your designing an urban context?

<i>Mechanism</i>	<i>Strongly disagree</i>	<i>agree</i>	<i>neutral</i>	<i>disagree</i>	<i>Strongly disagree</i>
<i>Upgrading the surrounding road network and/or intersections</i>					
<i>Providing sufficient car parking to meet demand</i>					
<i>Providing new and/or improved public transport services</i>					
<i>Providing a safe and connected walking and cycling network</i>					
<i>Incorporating a mix of land uses to potentially reduce the length and number of trips</i>					
<i>Developing and implementing a travel plan to encourage the use of more sustainable transport modes</i>					
<i>Other (please state): _____</i>					

3. What are the motivations for your agency requiring travel plans for existing developments (tick all that apply)?

- Mitigate transport impacts and improve accessibility
- Reduce requirements for road network upgrades
- Offset impacts of providing reduced levels of car parking
- Contribute to wider environmental objectives
- Provide a selling feature for new developments
- Deliver on council's transport policies and/or strategies
- Other

C. Overview about the current situation:

4. How many urban developments has your council required a travel plan for in the last five years?

- None*
- 1-2*
- 3-5*
- 6-10*
- more than 10*
- unsure*

5. Does your agency have a fixed guideway project in planning, design or construction? What comes closest to describing your situation? (tick all that apply)

Our projects in:

- Data collection.
- System planning.
- Alternatives analysis.
- Early stages of preliminary engineering.
- Advanced stages of preliminary engineering.
- Final design.
- In construction
- Coordinating between stakeholders.

6. What are the planning priorities that your agency takes in consideration while planning the land use?

<i>priority</i>	<i>Very important</i>	<i>Somewhat important</i>	<i>neutral</i>	<i>Little important</i>	<i>Not important</i>
<i>Community needs and population during specific period (____year)</i>					
<i>Financial capacity</i>					
<i>Available vacant land</i>					
<i>To be typical to regulation</i>					
<i>Solving existing urban problems (land use, transportation, environment, society and services)</i>					
<i>Solving existing transportation problems</i>					
<i>Other ()</i>					

7. Please, rate the importance of each urban service that can be considered while planning for the **neighborhood scale**.

<i>services</i>	<i>Very important</i>	<i>Somewhat important</i>	<i>neutral</i>	<i>Little important</i>	<i>Not important at all</i>
<i>Primary school</i>					
<i>Mosque</i>					
<i>Parks and green areas</i>					
<i>Commercial services</i>					
<i>Cultural services</i>					
<i>Health care services</i>					
<i>Official and institutional services</i>					
<i>Recreational services</i>					
<i>Public transportation</i>					
<i>Private transportation</i>					
<i>Car parking</i>					

8. On which category do you focus your attention while planning for cities? Please give a rating.

<i>Item</i>	<i>Very important</i>	<i>Somewhat important</i>	<i>neutral</i>	<i>Little important</i>	<i>Not important</i>
<i>Public transportation</i>					
<i>Private transportation</i>					
<i>Pedestrian environment</i>					
<i>Bicycle tracks</i>					
<i>Emergency services</i>					
<i>Other ()</i>					

9. What are the most perceived problems that you seek to solve and manage through development planning?

iii. Problems related to **Land use** _____

iv. Problems related to **Transportation** _____

v. Problems related to **Environment** _____

vi. Problems related to **Society** _____

vii. Problems related to **Services** _____

10. Which, if any, national/regional government policies do your agency currently employ to encourage:

- Mixed Land use
- Land use segregation
- Public Transportation
- Enhance Road network and traffic flow
- Walkability

D. Design elements

11. Based on your experience, how important is each **design element** to encourage walkability and usage of public transportation?

<i>Element</i>	<i>Very important</i>	<i>Somewhat important</i>	<i>neutral</i>	<i>Not important</i>
<i>Variety of ground surfaces</i>				
<i>Raised street crossings at intersections speed calming</i>				
<i>Outdoor seating (cafés and/or restaurants)</i>				
<i>Outdoor seating (public benches)</i>				
<i>Well-lit public spaces and footpaths</i>				
<i>Plantation</i>				
<i>walls adjacent to footpath (minimal or no setback on street level) (diversity/setback)</i>				
<i>Street awnings and/or arcades</i>				
<i>Large pedestrians' shed (accessible street network for pedestrians)</i>				
<i>Windows facing street</i>				
<i>landscape design elements</i>				
<i>Lighting</i>				
<i>Widening the sidewalks</i>				
<i>Other ()</i>				

E. The challenges facing the development process

12. Based on your experience, to what degree is each one of the following consider as a barrier to implement travel plans in the urban development?

<i>Impediment</i>	<i>Major barrier</i>	<i>Minor barrier</i>	<i>Not barrier</i>
<i>Community Opposition</i>			
<i>Local Zoning Restrictions</i>			
<i>Lack of Lender / Investor Interest and Support</i>			
<i>Lack of Developer Interest</i>			
<i>Skepticism Among Local Governments</i>			
<i>Lack of Political Support</i>			
<i>Location of public Stations</i>			
<i>Predominance of Auto-Oriented Land Uses</i>			
<i>Transit Agency Requirements for Replacement Parking</i>			
<i>Legal Issues</i>			
<i>Lack of Collaboration Between Participating Governmental Agencies</i>			
<i>Lack of financial support</i>			

F. Corporation

13. Does your agency have cooperative agreements with any of the public agencies to promote sustainable transportation trends?

YES NO

If YES, what are these agencies? _____

14. If you have any other comments in relation to transport planning for urban developments, particularly with respect to travel plans, please provide them in the space below:

Appendix D

Survey validation: by using SPSS software

A. GENERAL INFORMATION

Table D.1: correlation, questions (1-5).

		gender	age	educational degree	job
	Pearson Correlation	1	-.193	-.111	.191
	Sig. (2-tailed)		.057	.275	.060
	Pearson Correlation	-.193	1	.185	.027
	Sig. (2-tailed)	.057		.069	.792
	Pearson Correlation	-.111	.185	1	-.315**
	Sig. (2-tailed)	.275	.069		.002
	Pearson Correlation	.191	.027	-.315**	1
	Sig. (2-tailed)	.060	.792	.002	

** . Correlation is significant at the 0.01 level (2-tailed).

* . Correlation is significant at the 0.05 level (2-tailed).

Table D.2: reliability, questions (1-5).

Cronbach's Alpha ^a	N of Items
-.026	5

B. TRIPS AND TRANSPORTATION

Table D.3: correlation, questions (6-8).

		workplace	time to arrive to workplace	can walk on feet	last shifting
	Pearson Correlation	1	.243*	-.007	.003
	Sig. (2-tailed)		.016	.949	.975
	Pearson Correlation	.243*	1	.224*	.178
	Sig. (2-tailed)	.016		.027	.079
	Pearson Correlation	-.007	.224*	1	-.021
	Sig. (2-tailed)	.949	.027		.835
	Pearson Correlation	.003	.178	-.021	1
	Sig. (2-tailed)	.975	.079	.835	

** . Correlation is significant at the 0.01 level (2-tailed).

* . Correlation is significant at the 0.05 level (2-tailed).

Table D.4: reliability, questions (6-8).

Cronbach's Alpha	N of Items
.327	4

Table D.5: correlation, question (9).

		shopping	work trip	local leisure	visiting families	school for children	another local trip	shopping	work trip	local leisure	visiting families	school for children	another local trip
	Pearson Correlation	1	.342**	.408**	.537**	.407**	.432**	.051	.215*	.144	.110	.199	.285**
	Sig. (2-tailed)		.001	.000	.000	.000	.000	.617	.034	.157	.283	.051	.004
	Pearson Correlation	.342**	1	.200*	.186	.540**	.345**	.052	.344**	.191	.012	.213*	.180
	Sig. (2-tailed)	.001		.048	.067	.000	.000	.610	.001	.059	.905	.036	.076
	Pearson Correlation	.408**	.200*	1	.517**	.337**	.330**	.094	-.088	.073	.065	.042	.162
	Sig. (2-tailed)	.000	.048		.000	.001	.001	.355	.389	.474	.527	.685	.110
	Pearson Correlation	.537**	.186	.517**	1	.537**	.465**	.018	.022	-.100	.079	.183	.161
	Sig. (2-tailed)	.000	.067	.000		.000	.000	.862	.832	.327	.441	.072	.113
	Pearson Correlation	.407**	.540**	.337**	.537**	1	.445**	-.076	.126	.065	.089	.530**	.204*
	Sig. (2-tailed)	.000	.000	.001	.000		.000	.459	.215	.524	.383	.000	.044
	Pearson Correlation	.432**	.345**	.330**	.465**	.445**	1	-.005	.065	.051	.220*	.244*	.266**
	Sig. (2-tailed)	.000	.000	.001	.000	.000		.958	.522	.619	.030	.016	.008
	Pearson Correlation	.051	.052	.094	.018	-.076	-.005	1	.460**	.500**	.434**	.232*	.439**
	Sig. (2-tailed)	.617	.610	.355	.862	.459	.958		.000	.000	.000	.022	.000
	Pearson Correlation	.215*	.344**	-.088	.022	.126	.065	.460**	1	.438**	.448**	.402**	.447**
	Sig. (2-tailed)	.034	.001	.389	.832	.215	.522	.000		.000	.000	.000	.000
	Pearson Correlation	.144	.191	.073	-.100	.065	.051	.500**	.438**	1	.561**	.501**	.606**
	Sig. (2-tailed)	.157	.059	.474	.327	.524	.619	.000	.000		.000	.000	.000
	Pearson Correlation	.110	.012	.065	.079	.089	.220*	.434**	.448**	.561**	1	.589**	.700**
	Sig. (2-tailed)	.283	.905	.527	.441	.383	.030	.000	.000	.000		.000	.000
	Pearson Correlation	.199	.213*	.042	.183	.530**	.244*	.232*	.402**	.501**	.589**	1	.505**
	Sig. (2-tailed)	.051	.036	.685	.072	.000	.016	.022	.000	.000	.000		.000
	Pearson Correlation	.285**	.180	.162	.161	.204*	.266**	.439**	.447**	.606**	.700**	.505**	1
	Sig. (2-tailed)	.004	.076	.110	.113	.044	.008	.000	.000	.000	.000	.000	

** . Correlation is significant at the 0.01 level (2-tailed).

* . Correlation is significant at the 0.05 level (2-tailed).

Table D.6: reliability, question (9).

Cronbach's Alpha	N of Items
.813	12

C. ENVIRONMENTAL AWARENESS

Table D.7: correlation, question (10).

		using public transportation will help to tackle problems like climate change	cars do not have very negative environmental impact	walking/cycling reduce negative environmental impact	i consider fuel efficiency when i choose my car	i use telephone or internet to buy things to avoid travelling	i prefer buying things from closet store to avoid travelling	in the ideal world, i will use the environmental friendly choices of travelling
	Pearson Correlation	1	-.177	.330**	.076	-.019	.106	.298**
	Sig. (2-tailed)		.082	.001	.459	.852	.301	.003
	Pearson Correlation	-.177	1	-.227*	.126	.061	-.115	-.196
	Sig. (2-tailed)	.082		.025	.216	.552	.259	.053
	Pearson Correlation	.330**	-.227*	1	.176	-.003	.084	.200*
	Sig. (2-tailed)	.001	.025		.083	.980	.411	.048
	Pearson Correlation	.076	.126	.176	1	.189	.223*	.125
	Sig. (2-tailed)	.459	.216	.083		.064	.027	.218
	Pearson Correlation	-.019	.061	-.003	.189	1	.356**	.168
	Sig. (2-tailed)	.852	.552	.980	.064		.000	.100
	Pearson Correlation	.106	-.115	.084	.223*	.356**	1	.121
	Sig. (2-tailed)	.301	.259	.411	.027	.000		.237
	Pearson Correlation	.298**	-.196	.200*	.125	.168	.121	1
	Sig. (2-tailed)	.003	.053	.048	.218	.100	.237	

** . Correlation is significant at the 0.01 level (2-tailed).

* . Correlation is significant at the 0.05 level (2-tailed).

Table D.8: reliability, question (10).

Cronbach's Alpha	N of Items
.386	7

D. TRANSPORTATION AND URBAN FORM

Table D.9: correlation, question (11).

		do you agree the idea of existing all services in your area	do you think that a good transportation network may increase the quality of living	do you think that direct connection of your area to the city center and highways may efficient transportation system	do you think that your area has an easy access to the community services	do you find it easy to access to public transportation	do you find your area is safe to your children on roads	do you find the street in your area has a good furniture	do you find the street in your area have a good structure to encourage you for walking or cycling	do you like to spend time outdoor in your area	do you find any difficulty in park your car in your area
	Pearson Correlation	1	.353**	.292**	-.043	.223*	.198	.026	.072	.123	.037
	Sig. (2-tailed)		.000	.004	.673	.027	.051	.801	.480	.229	.715
	Pearson Correlation	.353**	1	.348**	.206*	.068	.181	.201*	.048	.014	.083
	Sig. (2-tailed)	.000		.000	.042	.509	.074	.047	.638	.890	.414
	Pearson Correlation	.292**	.348**	1	-.049	.013	.029	-.049	.086	-.054	-.016
	Sig. (2-tailed)	.004	.000		.635	.898	.777	.633	.399	.599	.877
	Pearson Correlation	-.043	.206*	-.049	1	.288**	-.080	.019	.057	.123	-.105
	Sig. (2-tailed)	.673	.042	.635		.004	.434	.854	.576	.226	.302
	Pearson Correlation	.223*	.068	.013	.288**	1	.306**	.232*	.247*	.238*	-.080
	Sig. (2-tailed)	.027	.509	.898	.004		.002	.021	.014	.018	.435
	Pearson Correlation	.198	.181	.029	-.080	.306**	1	.468**	.387**	.275**	-.052
	Sig. (2-tailed)	.051	.074	.777	.434	.002		.000	.000	.006	.610
	Pearson Correlation	.026	.201*	-.049	.019	.232*	.468**	1	.575**	.241*	.103
	Sig. (2-tailed)	.801	.047	.633	.854	.021	.000		.000	.017	.312
	Pearson Correlation	.072	.048	.086	.057	.247*	.387**	.575**	1	.259**	.165
	Sig. (2-tailed)	.480	.638	.399	.576	.014	.000	.000		.010	.105
	Pearson Correlation	.123	.014	-.054	.123	.238*	.275**	.241*	.259**	1	.137
	Sig. (2-tailed)	.229	.890	.599	.226	.018	.006	.017	.010		.179
	Pearson Correlation	.037	.083	-.016	-.105	-.080	-.052	.103	.165	.137	1
	Sig. (2-tailed)	.715	.414	.877	.302	.435	.610	.312	.105	.179	

** . Correlation is significant at the 0.01 level (2-tailed).

* . Correlation is significant at the 0.05 level (2-tailed).

Table D.10: reliability, question (11).

Cronbach's Alpha	N of Items
.651	11

E. TRAVEL ATTITUDE

Table D.11: correlation, question (12).

		using public transportation is convenient	public transport is affordable and has a good value	using public transportation is the safest travel choice	reducing car use is not an individual responsibility	increasing fuel taxes to discourage car use	giving buses priority on the roads	do you think the idea of encouraging the walking and using public transport can improve the social relationship between residents
	Pearson Correlation	1	.248*	.292**	-.174	.233*	.337**	.241*
	Sig. (2-tailed)		.014	.004	.086	.021	.001	.017
	Pearson Correlation	.248*	1	.155	.031	.206*	.109	-.002
	Sig. (2-tailed)	.014		.129	.764	.042	.286	.983
	Pearson Correlation	.292**	.155	1	.027	.143	.353**	.279**
	Sig. (2-tailed)	.004	.129		.795	.159	.000	.005
	Pearson Correlation	-.174	.031	.027	1	-.096	.137	.202*
	Sig. (2-tailed)	.086	.764	.795		.349	.179	.046
	Pearson Correlation	.233*	.206*	.143	-.096	1	.177	.210*
	Sig. (2-tailed)	.021	.042	.159	.349		.082	.038
	Pearson Correlation	.337**	.109	.353**	.137	.177	1	.464**
	Sig. (2-tailed)	.001	.286	.000	.179	.082		.000
	Pearson Correlation	.241*	-.002	.279**	.202*	.210*	.464**	1
	Sig. (2-tailed)	.017	.983	.005	.046	.038	.000	

** . Correlation is significant at the 0.01 level (2-tailed).

* . Correlation is significant at the 0.05 level (2-tailed).

Table D.11: reliability, question (12).

Cronbach's Alpha	N of Items
.752	15

